PRIMA
Full Proposal Template
Proposal template: technical annex (Part II)

From **E**dible sprouts to h**E**althy foo**D**
FEED

List of participants

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1. Excellence

1.1 Objectives

The objective of FEED is to improve the development of a new trend towards the consumption of "functional foods", using fresh sprouts of different botanical origins, with particular attention to traditional, local and wild edible species. Sprouts will be also formulated to produce new food ingredients and transformed to different functional foods (yoghurt, noodles, cookies/snacks, jellies), offering extra health benefits to meet the consumer demand while maintaining environmentally-friendly processes/products. In this scope, the specific objectives of FEED which will be achieved upon completion of the project are the following:

- To perform a deep characterization of bioactive compounds and *in vitro* antioxidants, and to test the immunomodulating and prebiotic effect of fresh sprouts from cultivated species and wild relatives or

local accessions of cultivated species. At least 20 genotypes will be analysed and about 10 best-performing sprouts will be selected.
- To assess the functional properties of the 10 best-performing sprouts by evaluating their *ex vivo* antioxidant capacity and their in vitro anti-inflammatory activity and the impact on the gut microbiota profile (*in vitro* and *in vivo*).
- To develop bio-based and biodegradable active packaging for extending the sprout shelf-life via coating or embedding microparticles containing active natural antioxidants and antimicrobial agents on biodegradable thermoplastic packaging films.
- To produce new food ingredients through the microencapsulation of sprout extracts and to assess the bioaccessibility of microencapsulated bioactive compounds. Identification of food ingredients with enhanced health-related beneficial and sustainable properties will be produced and tested.
- To produce new functional foods (e.g. yoghurt, noodles, snacks or jellied products) with the addition of fresh/processed sprouts by using innovative sustainable technologies such as additive manufacturing (e.g., 3D printing). Different kinds of food hydrocolloids and food grade antimicrobial agents will be investigated in order to improve rheological and texture properties as well as to improve microbial stability. Functional products based on sprouts will be developed through three-dimensional (3D) food printing to meet individual customer requirements in terms of colour, shape, taste, texture and nutritional value.
- To evaluate the performance and impact of innovative non-thermal technologies (e.g., high-power ultrasound, pulsed electric fields, etc.) as pre-treatment of 3D printable mass to increase bioavailability of bioactive compounds and improve shelf-life of 3D-products. Based on the physical, sensory and nutritional properties of 3D-products, the best processing conditions will be selected.
- To promote the distribution at industrial level of local and healthy sprouts-based products by engaging at least 2 SMEs and smallholders as project partners and preparing with them business models for quality and sustainability.
- To promote healthy and sustainable diets among Mediterranean consumers by assessing their products acceptability and increasing their social awareness.
- To produce the prototypes for all products at pilot scale so that a TLR from 4 to 6 would have been achieved.

1.2 Relation to call and topic

CALL: Section 2-Thematic Area 3 - Agro-food value chain; **Topic:** 2.3.1 (RIA) Enabling the transition to healthy and sustainable dietary behaviour.

Challenges: There is a relationship between dietary habits and health (Kovačević et al., 2020). Epidemiological studies have associated the higher consumption of plant-derived food, rich in phenolics, to lower risk of several chronic and degenerative diseases, such as cancer, cardiovascular diseases, obesity, diabetes, inflammatory diseases (Pająk et al., 2014.). Vegetables constitute a great part of the Mediterranean diet but, despite the numerous recommendations to consume vegetables, there are some difficulties in implementing this habit particularly among the youngest generation. This has been partially attributed to the rapid dissemination of Western-type diets, to food-globalisation (Cavaliere et al., 2018). Moreover, the habits of the society, with less time devoted to preparing meals, even in the Mediterranean region, have shifted towards the convenience of highly processed and takeout food, with evident adverse effects on the population: increase of chronic diseases, autoimmune diseases, obesity and cancers in areas where they were at the lowest levels until fifty-sixty years ago. On the other hand, millenials and the young population are becoming aware of the need to shift towards healthy food minimally processed and coming from ethic and natural sources. Taking these considerations into account, FEED project, aiming to **encourage the consumption** of plant sprouts, the transition from animal-based to **vegetal-based products**, seeks to respond to both the need of producing **functional foods** and that of a **sustainability production**. What is more, with the recent coronavirus outbreak, the demand for functional foods to improve body immunity is on the rise (Le et al., 2020). Indeed, sprouts have been associated with a variety of biologically active constituents with potential health benefits and also can be produced quickly, easily, and cost-effectively due to simple requirements for equipment and supplies, and a rapid developmental process of a few days. FEED will also promote the sprout consumption both as fresh or processed products, through the evaluation of their antioxidant potential on *in vitro* and *ex-vivo*

systems, and by assessing in animal model the effects of their consumption on some **chronic diseases** (i.e. inflammatory processes) and on the gut microbiota. Considering also that fresh sprouts are perishable, FEED plans the development of an appropriate and **sustainable packaging system**, such as compostable/biodegradable or edible active packaging to further increase sprouts nutritional properties as well as to extend their shelf life. Existing combination of information and communication solutions will likely launch the 4th industrial revolution in the near future, due to particular emphasis on additive technologies that is led by the 3D printing technology (3DP) in the food industry. 3DP is a relatively fast process of additive layer production where through computer models it is possible to produce 3D products of different shapes (Tomašević et al., 2021). 3DP of food is a sustainable food technology that with lower energetic requirements can use alternative sources of raw materials to produce functional products according to individual consumer needs and also reduces waste. Hence, FEED will apply **innovative sustainable technology** (3D printing and microencapsulation) to explore the possibility of using dried sprouts powder to obtain processed functional foods (e.g. fruit-based jellies or snacks). **Bioaccessibility** of the microencapsulated bioactive compounds in the food matrix will be investigated by FEED. Moreover, since 3DP-products are often products with short shelf-life, the use of innovative non-thermal processing technologies (e.g. HPU, PEF) as pre-treatment to extend shelf life and maintain nutritional quality of 3DP-functional products will be examined, too. Consumer acceptance, and sensory analyses will be considered. Sensibilization campaigns involving living labs especially addressed to youngest consumers, teachers and families will be organised at European levels to understand how FEED project results will help the diffusion of the habit to use plant sprouts.

Scope: In FEED, a wide range of sprouted vegetables from a broad diversity of seeds among legumes, cereals and vegetables, will be assessed for their biological activities and human health benefits. They will be chosen among mediterranean, traditional and wild edible species with expected higher levels of bioactive compounds. To determine the functional properties of the obtained sprouts two parameters will be evaluated, the *in vitro* and *ex-vivo* antioxidant capacity and the in vitro anti-inflammatory activity. Then, to prove the health benefits of a diet integrated with sprouts, the effects on microbiota composition will be assessed. The vegetable sprouts will be proposed fresh or through microencapsulation of dried extracts to be used as food ingredients for the preparation of novel functional foods, such as yoghurt, noodles, snacks or jellied products. To this purpose, an innovative sustainable technology will be employed such as additive manufacturing (e.g., 3D printing). Consumer and sensory studies of the obtained products will be performed at country specific level. Besides the nutritional aspects, the sprout production process is in line with the concept of low environmental-impact cultivation as the germination requires only water and no phytochemicals are needed as indicated by the "Farm to Fork" strategy and by consumer expectations (COM (2020) 381 final). FEED also takes into account the environmental sustainability for the packaging of the fresh sprouts through the preparation of biodegradable edible active packaging. The carbon footprint analyses of the developed products will aid to assess the environmental impacts of the products by estimating the GHGs emission for the entire life cycle of the products (from cultivation to packaging). This evaluation represents a winning marketing strategy for a consumer that is more and more aware of the environmental impacts of its purchases. The planned information campaign activities of FEED through educational and training online events, living-labs, educational toolkits (games development, e-books) will reach consumers and the market for the evaluation of receptivity. This activity will contribute to increasing awareness of the general benefits of the sprout based diet, that is part of the Mediterranean diet, at all-age levels.

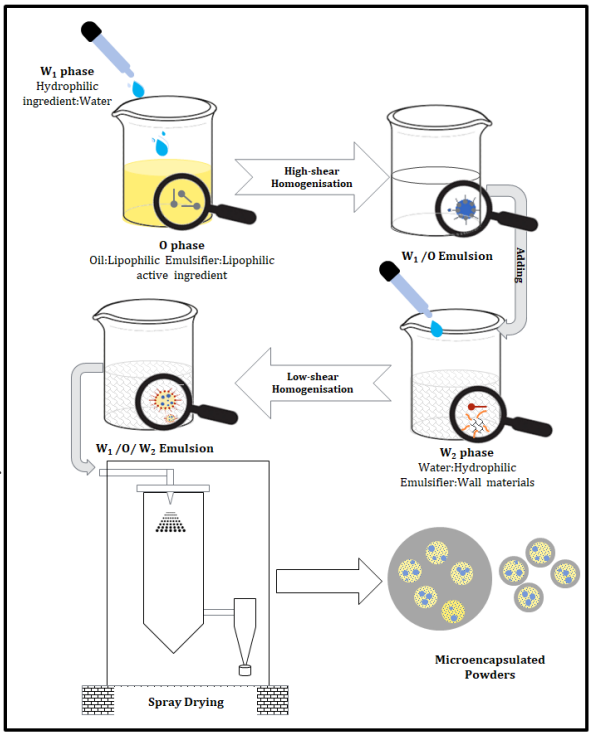
1.3 Concept and methodology

(a) Concept: Epidemiological studies have demonstrated that diets rich in fruits, vegetables and grains containing high amounts of phenolic compounds are associated with a reduced risk of chronic and degenerative diseases (Nayak et al. 2015). As people become increasingly conscious about the relationship between diets and health, attention is shifting towards assessing better methods to improve the functionality of foods. Recently, sprouted edible seeds, widely used as vegetables in Southeast Asia, are growing popular in human diets also in Western countries. For this reason the European Commission has established a strict definition of sprouts: "the products obtained from seed germination, harvested before the development of the first leaf and fully consumed including the

seed" (EU regulation 208/2013). Seeds and sprouts of different botanical origin due to their numerous pro-health benefits, including prevention of cardiovascular diseases and diabetes type 1 or 2, bowel regulation, reduction of obesity, cholesterol and triglycerides levels, are an important raw materials for functional foods (Pandey et al., 2009). The described bioactive effects result from their unique composition: low fat content and high health-promoting phytochemicals such as phenols, flavonoids, vitamins, phytoestrogens, amino acids, and minerals (Mattioli et al., 2019). Particularly, phenolics may act as reducing agents, hydrogen donors, singlet oxygen quenchers and metal chelators because of their antioxidant properties. **Why should sprouts be better than their seeds counterpart?** The answer lies in the germination process during which the endogenous enzymes are activated and storage nutritional compounds are converted to bioactive components. When plant seeds germinate and a shoot emerges, the endogenous enzymes are activated and the degradation of sugars, free amino acids, and organic acids is significantly increased. The plant sprout foods show a higher nutritional composition including amino acid, protein, fatty acid, vitamin, sugar, and macro- and micro-elements. Most importantly, germination is conducive to the accumulation of phytochemicals, phenolics, and flavonoids, which have antioxidant activity. The de novo synthesis of phytochemicals occurring during germination has the function to protect the plant from exogenous challenges and at the same time acts as health-enhancing ingredients. As a result, the nutrient levels and bioavailability in sprouted seeds are improved. As an example, vitamin C, which is famous for its physiological functions in animals and plants, barely exists in soybeans but significantly increases in soybean sprouts (Shi et al., 2010). Interestingly, compared to seeds and mature plants, sprouts contain a low amount of antinutritional factors. The habits to eat these foods is also in line with the current dietary guidelines that advocate more plant-based diets, but also related to environmental concerns (Magkos et al., 2020). Sprouts can be produced quickly, easily, and cost-effectively, due to simple requirements for germination, and a rapid developmental process. The sprout production is low-input requiring only water to start germination and no sunlight is needed, therefore is not limited by the season. This, in turn, suggests a unique opportunity for industrial scalability coupled with the prospect for consumers to independently access food with proven nutritional benefits. In the last decade the scientific literature on sprouts has increased, and the focus has been most on cultivated species. The FEED project will focus on sprouting species poorly investigated such as wild relatives or local accessions of cultivated species, because they are supposed to have a higher phytochemical content compared to cultivated ones (Nemzer et al., 2020). To this regard, flax varieties and wild flax species, hemp varieties, milk thistle (*Silybum marianum*), white mustard (*Sinapis alba*), together with aromatics (i.e. basil, perilla) and other species belonging to *Leguminosae*, *Brassicaceae,* and cereals will be investigated. Each group is characterised by the presence of a typical class of phenols with specific bioactivities (Galieni et al., 2020). For example flax is rich in lignans, broccoli and brassicaceae are rich in glucosinolates and anthocyanins. The metabolic profile generated by FEED will be able to associate a specific biological activity, antioxidant, anti-inflammatory, to the class of compounds present in a particular sprout species. Over time scientific literature on health benefits of germinated edible seeds has increased. However, there are still several aspects that require more insights such as the effect of eating sprouts on the intestinal microbiota. The role of diet in modulating the intestinal microbiota and the consequent effect on the production of metabolites beneficial for intestinal health has now been demonstrated (De Filippo et al., 2010), and for this reason it is extremely important to define foods capable of exercising a prebiotic function in order to promote growth of a microbial community capable of increasing the endogenous production of short chain fatty acids (SCFAs), known for their inflammatory properties. For this purpose, the sprouts selected on the basis of the composition will be tested in *in vitro*, *ex vivo* and *in vivo* models in order to identify potential prebiotic properties.

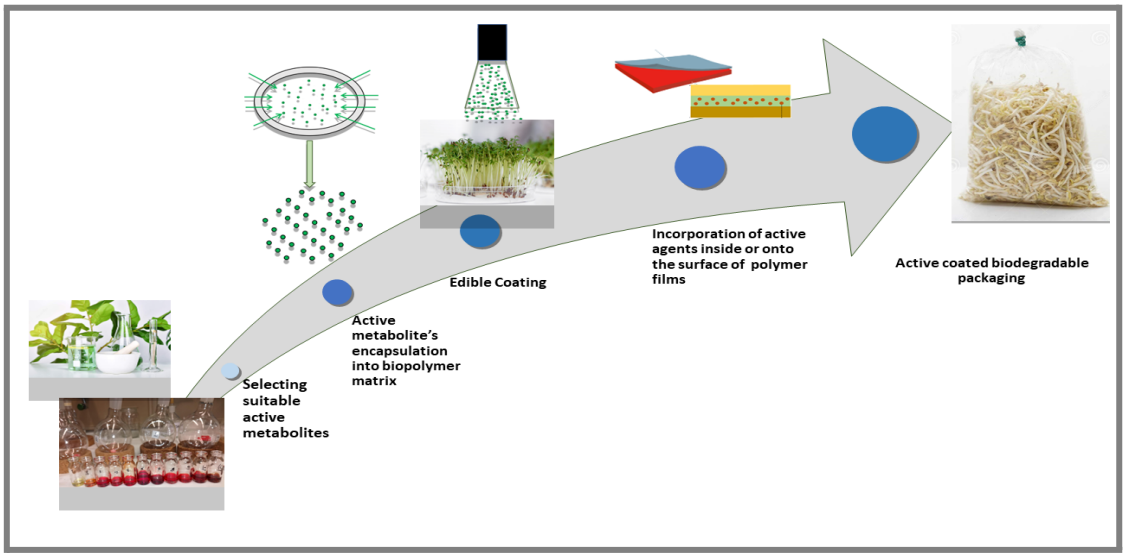
The sprouts selected for their best bioactive properties will be the raw materials to produce extracts for the production of new food additives through microencapsulation process (see figure below). This technique will allow the preservation of sprout bioactive compounds against the thermal treatment, fermentation, and gastrointestinal digestion. Microencapsulation is mainly based on covering the valuable components to be protected with wall materials and transforming it into a more stable form such as powder. Considering production costs and applicability in food, the most efficient and widely used techniques are based on the spray drying of the emulsion in which the valuable component was

entrapped. In this regard, the microencapsulation technique should be detailed according to the hydrophobic or hydrophilic nature of the bioactive material, and the wall materials should be selected according to the aim of the microencapsulation. The microencapsulation of fats and valuable fat-soluble components (flavour components, antimicrobials, omega-3 fatty acids, conjugated linoleic acid, carotenoids, vitamins A and D, phytosterols, etc.) can be carried out by the spray drying of O/W emulsions including the valuable components in the dispersed phase (Chawda et al., 2017; Tan et al., 2022). However, the microencapsulation of hydrophilic active materials for food applications is more challenging and few studies were carried out in the literature (McClements, 2018). To overcome the problems of water-soluble components encapsulation, preparing double emulsions (W/O/W) and converting them into powder offers a good alternative (Adachi et al., 2003; Brückner et al., 2007; Lee et al., 2013; Bušić et al., 2018). In a recently funded project "Production of microencapsulated casein hydrolysate as a bioactive food additive by double emulsion/spray drying technique" the encapsulation of hydrophilic casein hydrolysate by double-emulsion/spray drying with different protein/carbohydrate combinations as wall materials to enhance bioaccessibility has been studied. Similar problems are expected to be faced and the experience gained in both studies will contribute to both projects.

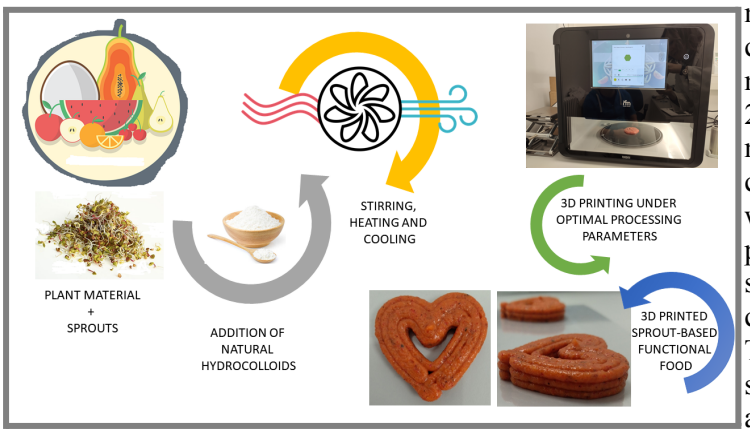


Another issue regards the sprouts microbiological safety that must be ensured since they are a perishable material. In addition to microbial contamination, sprouts have a comparatively high-water content, and a delicate structure, which is susceptible to damage that may affect the sensory properties and nutritional value, and compromise their shelf-life, leading to significant economic losses for producers (Zhang et al., 2018). Indeed, the influential parameters on the sprouts' shelf-life are post-harvest browning, decay, lignification, and physiological and microbial effects. The key enzymes of sprouts browning are polyphenol oxidase (PPO), peroxidase (POD), and phenylalanine ammonia-lyase (PAL). These enzymes' catalytic activity with phenolic compounds increased during the sprout's maturation process. In this respect, traditional food preservation methods like salting and heat application change the foods' flavour, odour, colour, and textural properties, especially of susceptible food like sprouts. Therefore, a work package (WP4) has been specifically devoted to the development of active packaging techniques (Moeini et al., 2018; Marturano et al., 2019) to exploit essential functions, including containment and protection of sprouts, while preserving food sensorial quality and safety, extending their shelf-life, and retaining their beneficial effects (Moccia et al., 2020; Moeini et al., 2020). In this respect, the envisaged approach to sprout sustainable packaging will be inspired by the edible coating technique. The latter consists of a thin layers of edible polymer applied to the surface of the food inside the packaging material to improve the quality of products via shielding them from natural deterioration processes due to oxidation, moisture absorption/desorption, oils, gas, or to provide vapours barrier management, and antimicrobial properties. Moreover, the edible coating reduces particle clustering and enhances food surface visual and tactile features (Moeini et al., 2021). The edible coatings are eaten as part of the total product. That is why edible biopolymers, such as polysaccharides, proteins, lipids, and food-grade additives, as antimicrobial agents and plasticizers, are the most used materials for the coating packages. On this basis, FEED will develop innovative active packaging by formulating antioxidants and antimicrobial compounds in bio-based and biodegradable edible coatings and active thermoplastic packaging to extend the sprout shelf-life and safety. Among different active antioxidant and antimicrobial agents, natural secondary

compounds (essential oils and natural metabolites) of plants and fungal could be potentially considered as the most promising materials which can extend the food shelf-life because of their multifunctional structure, which also affects the package's mechanical performance and gas and water barriers (Moeini et al., 2021).
Proteins such as corn zein, whey and soy proteins, because of their wide range of degradability, low price, availability, and hydrophobic nature will be screened as promising biopolymers used as a carrier of active agents and coating of the sprout packaging. Finally, biobased and biodegradable thermoplastic polymers including polyesters or cellulose will be screened as suitable substrate films for the development of coated active packaging.



The main activities of this WP will consist in the design, synthesis and characterization of bio-based and biodegradable active packaging for extending the sprout shelf-life via coating active natural antioxidants and antimicrobials-encapsulated microparticles on the surface of the bio packaging system. Complying with the EU strategy on Plastic Recyclability and Biodegradability and the European Food Safety Authority (EFSA) for the list of substances that can also be used in contact with food, the microcapsules and thermoplastic films will be fabricated based on naturally occurring polymers and natural resources. Then, the biodegradable polymers will be used to prepare loaded microcapsules with the selected active agents by BGT. The microcapsule fabrication and functional packaging characterization, loading efficiency, and releasing rate will be measured by BGT and CNR, while the capacity of the new active packaging in preserving the quality of sprouts along their shelf-life will be investigated by CREA (WP5). A schematics of the envisaged activity of WP4 in the frame of the work plan of FEED is reported above.
FEED will also develop an additional strategy to make the bioactive compounds of sprouts available to consumers by the use of 3D printing (3DP). It is believed that the use of this technique can eliminate many shortcomings of traditional food production and thus accelerate the development of new food products that meet today's consumer demands in price, taste, and nutritional composition (Dankar et al., 2018). This type of food design offers numerous advantages, as the shape and composition can be freely defined, which meets individual needs for personalised nutrition. In addition, the supply chain is simplified and the choice of available foods is expanded. Therefore, FEED will implement a sustainable additive manufacturing application such as 3DP to design



sprout-based functional products of unique composition, geometry and extended shelf-life oriented to target consumer groups. A scheme of the 3DP approach to design customised sprout-based functional food targeted to specific consumer groups is reported above. Recently, the use of innovative non-thermal technologies has found its place in industrial applications, whether as pre-treatment or in food processing. They have low greenhouse gas emissions and energy consumption, and reduced environmental impacts, hence considered sustainable technologies that are in line with Agenda 2030 which is geared towards their use. These technologies cause ruptures of cell membranes, which can significantly increase the bioavailability of bioactive compounds. In addition, these technologies have a positive effect on the inactivation of microorganisms and prolonged product stability (Putnik et al., 2019). FEED will apply 3DP to the formulation of sprout-based functional foods by using various additives and/or food-grade antimicrobials to create products with well-defined composition, shape, sensory properties, and microbiological stability. To increase bioavailability of bioactive compounds and extend shelf-life of functional products, FEED will apply non-thermal technologies (e.g. HPU, PEF) as pre-treatment for 3DP technology, individually and/or in combination considering optimal physical, chemical, nutritional and sensory properties. The technology of 3DP requires heating the edible ingredients before printing them layer by layer on the build plate. Therefore, the use of non-thermal technologies will be investigated to test whether the printed mass can be better infused with additives without the application of heat. In this way, the preservation of the original quality could be better maintained, and this approach could further extend the shelf-life of 3DP. The efficiency of the PEF treatment depends on several factors such as electrical field strength, processing time, pulse width, frequency and shape of the pulse, polarity, energy and temperature applied, while parameters influencing the effectiveness of HPU treatment are ultrasonic strength, frequency, ultrasonic probe diameter, amplitude, time of treatment, and temperature. Therefore, after testing all the processing parameters of these non-thermal technologies, the pretreatment process will be optimised and used for further experiments. In addition, for successful 3D food printing, it is necessary to optimise process parameters such as nozzle size, printing speed, flow rate of ingredients, distance between layers as well as pre-heat temperature and time. The best parameters of 3D printing will be taken into consideration in further experiments.

"From - to" Technological readiness levels (TRL) of FEED: For all stages, FEED will start from a TRL of 4. All technologies that will be used have already been laboratory validated. Upon completion of FEED the following TLRs would have been achieved for the specific activity:

1. Production of the new food ingredient from sprout extract using the best technology for microencapsulation at pilot scale (TRL 6)
2. Production of at least one edible coating and one active packaging that will enhance the shelf-life of fresh-sprouts (TRL 6)
3. Production of the prototypes of at least two functional products (yoghourt, noodles and snacks) that will give the best results in terms of sensory and consumer preference (TRL 6)

The partners in this consortium have various experience in national and international projects that will improve the quality of the research activities in FEED. Moreover, the FEED will create synergies with existing research projects.

(b) Methodology: The overall methodology of FEED and the distinguishing activities indicated in the relevant section of the Work Program has been explained in terms of Work Packages (WPs) as done in the 1st stage of the proposal. In this 2nd stage, WPs will be discussed in detail in the Implementation section of the proposal (Section 3.1) with more concrete deliverables and tasks of the partners. However, to give a general idea about the methodology that will be followed, WPs are summarised below as described in the 1st stage as follows. FEED will consist of 10 WPs which include all activities from management to pilot production accompanied by the dissemination activities.

Brief Summary of WPs

WP1. Sprout production from different plant species: in this WP, ARO and CNR will be the main contributors. ARO will sub-contract Al Alim Medicinal Herb Centre Ltd. and Udi's Sprouts for sprouts growing. Seeds of cultivated species will be acquired from seed companies and local vendors, whereas seeds of wild species will be collected from the wild in Israel and grown under controlled greenhouse conditions for mass production of seeds. ARO and CNR will focus on the production of

sprouts of both cultivated and spontaneous species in a controlled environment. Initially, etiolated sprouts of all species will be grown under total darkness and then other growing conditions will be tested for enhancing bioactive components. **WP2. High throughput Screening of the different sprouts.** In this WP, CNR, CREA, ARO, and CSIC will be the main contributors. The screening will be carried out with the aim of selecting the most health-promoting sprouts species. To this aim, CNR, CREA and ARO will work on the extraction and first rapid high throughput screening of the main classes of bioactive compounds (through HPLC and UV-VIS spectrophotometric measurements) and the determination of their *in vitro* antioxidant activity (DPPH, superoxide anion and hydroxyl radical quenching capacity through Electron Paramagnetic Resonance analysis). Moreover, the content of antinutritional compounds (i.e. phytic acid, trypsin inhibitor) will be measured. CSIC will perform tests for *in vitro* immuno-modulation and *in vitro* prebiotic effects. The best performing 10 sprout species will undergo a deep chemical characterization through Mass-spectrometry and NMR to profile the healthy compounds (CREA). **WP3. Experimental Models: advanced *in vitro* and *in vivo* models to validate beneficial selected sprouts-host interaction.** This WP will include contributions from CNR and CSIC. The *ex*-vivo antioxidant activity and *in vitro* anti-inflammatory effects of sprouts selected in WP2 will be performed by CNR. *Ex vivo* tests will be carried out on human red blood cells to determine the cellular antioxidant activity (CAA-RBC) and *in vitro* assays will evaluate the inhibitory effect of selected sprouts on Cyclooxygenases (COX), the target enzymes of the anti-inflammatory activity of non-steroidal anti-inflammatory drugs. In addition, *in vitro* screening assays will be performed following two approaches: static *in vitro* colonic fermentation and intestinal cell models and also, in combination with immune cells. These latter experiments will be conducted with the guidance of partners from CSIC. These results would offer a screening for the next animal studies. Finally, changes in gut microbiota profiles associated with a specific diet containing the selected sprouts will be evaluated by CNR to verify a possible positive effect of sprouts on gut health in animal models. To test the prebiotic role of selected sprout preparations (sSP) on gut microbiota we will use an animal model, F344 rats aged 7 weeks (12/group) treated with 4 different sSP for three months. At the end of the experiment the identification of the intestinal microbial communities (Bacteria and Fungi) with the relative metabolomics profiles, and the status of intestinal epithelial barrier will be carried out. **WP4. Development of edible coatings and biodegradable active packaging.** In this WP, CNR and BGT will develop microcapsules and coated active packaging films based on naturally occurring and/or biodegradable polymers. In particular, polysaccharides, proteins, and polyesters will be selected for manufacturing microcapsules loaded with commercial molecules having high bioactive properties and possibly sprout extracts. Different techniques such as coacervation, precipitation, spray-drying, single or double emulsion, and microfluidic will be investigated for manufacturing the microparticles. FTIR, UV-Vis spectroscopy, thermal analysis (TGA and DSC), and SEM will probe the active agent encapsulation, and the particle size. Then, the drug loading efficiency and the release rate will be evaluated by UV-VIS or HPLC. Once the optimal formulations will be identified, laboratory-scale development of edible coatings by dipping or spraying onto sprouts will be tackled (BGT and ATU). Besides, incorporation of the particles in the thermoplastic films will be carried out. Surface immobilisation by spray or layer-by-layer coating, or incorporation by blending and extrusion will be investigated to select the most convenient technique for producing an active packaging system (CNR). Active packaging characterization, loading efficiency, and release rate will be assessed by thermal analysis (DSC and TGA), FTIR, and X-ray diffraction (XRD). Size, surface potential, particle density will be studied by dynamic light scattering (DLS), optical and electron microscopy, and Energy Dispersive Spectroscopy (EDS). Furthermore, the mechanical characteristics will be measured. **WP5. Quality characteristics and shelf-life of packed products**: In this WP, where CREA will be the main contributor, the preservation of sprouts quality throughout shelf-life effect will be studied using two approaches: modified atmosphere packaging and use of innovative packaging (produced in WP4). Physicochemical properties will be considered, and the nutritional quality will be evaluated by measuring the content of bioactive metabolites and *in vitro* antioxidant activity, and by monitoring the development of off-flavours and possible microbial contaminants and possible microbial contaminants. Finally, the sensory properties of the products will be also analysed and evaluated by a trained panel. **WP6. Microencapsulation of bioactive compounds for use as food ingredients** (ATÜ): Microencapsulation will be performed to convert the

sprout extract, which has been determined to have high bioactive properties, into a food additive. The emulsion/spray drying technique will be used in the microencapsulation process. Emulsions will be produced depending on the hydrophobic/hydrophilic nature of the bioactive components of the extracts, followed by spray drying. Different protein-carbohydrate combinations will be used as wall material in microencapsulation and the appropriate combination will be determined. Then, factors related to formulation (protein: carbohydrate ratio and wall material concentration) and spray drying process conditions (inlet temperature, feed rate, aspiration rate, etc.) will be optimised. Response surface methodology will be used in the optimisation and the properties of the emulsions, the physical and microstructural properties of powders, the microencapsulation efficiency, and the bioaccessibility of the bioactive components will be analysed. The storage stability of the final microencapsulated powder product will also be determined, and its potential for use as a food additive will be investigated. In this context, 2 different traditional Turkish foods, a drinkable yoghurt "Ayran" and Turkish noodles "Erişte", will be selected to demonstrate the effects of microencapsulation on different food processes (fermentation/heat treatments). The composition, physical and chemical quality characteristics will be examined, sensory analyses will be carried out and the bioaccessibility of the microencapsulated bioactive compounds in the food matrix will be investigated by *in vitro* gastrointestinal digestion study. **WP7. Production of snacks and jelly food containing the selected healthy sprouts** (UNIZG): In this WP, the nutritional and bioactive potential of various plant source material (e.g., fruits/legumes/food industry by-products, etc.) will be investigated as potential bases for the production of 3DP snack products and/or cooked food. After selecting the appropriate plant matrix, additive 3DP manufacturing will be conducted by the addition of sprouts (either fresh or processed). Different types of hydrocolloids will be investigated to find the optimal viscosity of 3DP mass. The 3D printing process will be optimised with respect to operating conditions. As regards to the 3D printing/production of jelly products, the application of sustainable non-thermal technologies such as high power ultrasound (HPU) and/or pulsed electric fields (PEF) as pre-treatment will be investigated with the aim of increasing the bioavailability of bioactive compounds in sprouts as well as in plant matrices. Jelly products will be developed with different proportions and/or types of pectin and reduced energy value, which refers to the reduced sugar content. The proportion of added sprouts (either fresh or processed) in these products will be optimised in terms of quality parameters such as sensory, physicochemical composition and nutritional and biological value. **WP8. Consumer acceptance and social awareness** (AIJU, ITB, Argonauta): The FEED project is aware of the great added value that consumers bring to the project development as well as of the importance to raise awareness on healthy habits and a more sustainable diet. For this reason, WP8 will be specifically dedicated to understand consumers' perception on the new FEED products as well as adopt the most effective communication strategies to provoke a change in the consumers' diet behaviour according to their lifestyle. Particular attention will be given to implement activities to help youngsters and adolescents to shift towards Mediterranean healthy dietary behaviours. Therefore, test, educational e-manual for secondary school teachers and youth workers and trainers will be produced and ready to use teaching materials will be provided. Also an interactive website and online archive about Mediterranean food with connected social network channels by redeeming sources that had been scattered across the Mediterranean region will be set-up. Non-formal education tools: group work, discussion, role-play, team-building, communication strategy for social network (tiktok, Instagram), piloting-testing, board game with the topic of healthy Med food, interdisciplinary teaching units preparation materials, school challenges, field work, live social labs, promotional events will be organised. These innovative activities will serve to promote healthy dietary behaviour change for the target groups combining science with educational and non-profit sector actors, and will build social networks communities around Mediterranean food traditions. The carbon footprint analysis will integrate these activities, as a winning marketing strategy for more aware consumers. The carbon footprint will follow a cradle-to-gate approach and will be conducted on 2 FEED products, on the basis of their performance evaluated in WP5. This activity will follow the PEF (Product Environmental Footprint) methodology developed by the European Commission's Joint Research Center (JRC) that provides a common way of measuring environmental performance for companies within the EU wishing to market their product. **WP9. Communication and dissemination** (ITB; Participants: ALL): The communication and dissemination activities carried out in WP9 integrate the

specific activities dedicated to consumers (WP8) by engaging a large number of stakeholders, including the scientific community and other funded projects, SMEs and smallholders and policymakers. Target audiences of the communication and dissemination activities, the expected results and measures to achieve these results are described in detail in Table 2a, while activities are detailed in Table 2b (dissemination) and 2c (communication). The communication and dissemination activities will be aligned with the project exploitation strategy, including a draft of this latter in the communication and dissemination plan.

WP10. Management & Coordination: Management and Coordination activities with partners will be coordinated by CNR.

Gender dimension: Consistent with findings in the literature that shows how females are more likely to adopt a vegan diet and consume less meat (Modlinska et al., 2020), this activity will take into account the **gender dimension** when implementing consumers' dedicated activities (WP8), evaluating consumers' behaviour by gender and considering possible differences when project information is communicated (WP9). Besides gender, other factors such as age, ethnicity, education etc. will be taken into account when evaluating consumers' perception and developing communication materials. Indeed, FEED project pays great attention in supporting the importance of gender dimension in the R&I design, implementation and execution, aligning with the priorities outlined in the EU's objectives and in the EU Gender Equality Strategy. For this reason, the project management (WP10) will ensure gender balance in the consortium (6 women and 4 men among PI lead participants), also taking into account this issue in all partners' hiring process.

1.4 Ambition

As people become increasingly conscious about the relationship between diets and health, attention is shifting towards assessing better methods to improve the functionality of foods. Recently, there has been a growing popularity of plant sprouts in human diets which are regarded as a functional food (Geng et al. 2021). Initially, germinated legume seeds were the major type of sprouts consumed in the diet, currently, a diverse range of sprouted foods originating from a broad range of seeds such as alfalfa, buckwheat, red cabbage, and broccoli sprouts are consumed. FEED aims to enrich the offering of edible sprouts by exploring the use and health properties of about 20 cultivated species, within which wild relatives or Mediterranean native that are expected to have higher levels of bioactive compounds. A deep metabolic characterization of the produced sprouts together with the microbiota changes associated to diets enriched with specific sprouts, will establish a relation between the diet and the inflammatory status of the cells. This is an ambitious achievement of FEED not yet described in literature. FEED aims also to use dried flour from sprouts to produce processed food by the use of innovative techniques: microencapsulation to produce two different traditional Turkish foods will be prepared: a drinkable yoghurt "Ayran" and Turkish noodles "Erişte", and an additive technologies (3D printing) with the aid of non-thermal innovative pre-treatments (e.g., high-power ultrasound, pulsed electric fields, etc.) to produce snacks and low-sugar jellies. These functional food products will sound very attractive to the children and young people, the one to FEED is mostly addressed. To close the loop, FEED will develop a sustainable packaging for fresh sprouts to extend the shelf-life maintaining the activity of healthy compounds.

2. Impact

2.1 Expected impacts: The expected impacts that are addressed in the scope of the call have been matched with the context as follows:

- FEED will develop sprouts from different plant species as a good health contributor to diet. Aiming at developing new vegetable-based products active on chronic diseases (i.e. cardiovascular, inflammatory), the project will thus contribute to reducing the pressure on the healthcare systems. In this context, FEED will be addressing the SDG 3, target 3.4, that targets "the reduction by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being by 2030".

FEED will also develop:

- Microencapsulation strategies and formulations to preserve the bioactive compounds of sprouts against the thermal treatment, fermentation, and gastrointestinal digestion with the aim to maintain their nutritional quality;

- ❖ Biobased and biodegradable active packaging to extend sprouts shelf-life and preserve bioactive compounds;
- ❖ New and healthy low-processed food products in acceptable and attractive formats that would be healthy alternatives particularly for children and young people: yoghurt, noodles, low-sugar jellies and snacks. These new products could be attractive for small-medium companies dealing with healthy food ingredients.

FEED will promote:

- ❖ Mediterranean dietary habits highlighting the benefits of consuming sprouts both fresh or processed through awareness campaigns mainly in schools and communities;
- ❖ Incentives and information provision to consumers and policymakers will be provided by E-manual for secondary school teachers and/or youth trainers, living-labs and games addressed to children and youth, consumer guides, educational webinars. In these guides and webinars special consideration will be given to highlight the importance of sustainable consumption also through carbon footprint analyses that will help in the obtainment of the environmentally friendly production of these foods.
- ❖ FEED will link to relevant EU policies and objectives in the context of the European Green Deal (Farm to fork strategy) in the action of reducing the use of pesticides, antimicrobials and excess fertilisation, since the sprout production does not involve intensive agriculture.

2.2 Measures to maximise impact

(a)Dissemination and exploitation of results: FEED aims not only to a product development goal but it will also develop strategies to increase awareness of its products among the Mediterranean consumers by developing a series of dedicated activities in WP8 and WP9. To ensure broad uptake of project results during and after project end, FEED encompasses a multi-disciplinary, integrated, and participatory approach gathering universities, research institutions, consortiums and food SMEs and involving, through the wide network of its partners, other relevant target audiences and stakeholders as described in table 2a.

Table 2a. Potential users and expected results

Target Group	Expected Results	Measures to achieve results
A. Scientific community and Other funded projects	● Knowledge generation ● Knowledge-exchange on critical issues ● Scientific exploitation ● Publication in open access peer-reviewed journals and technical magazine ● Increase networking ● Increase knowledge and good practices	● Articles/reviews in open access peer reviewed journals ● Scientific conferences ● Dedicated press releases ● Networking activities with other funded projects, including webinar and one online joint thematic event on healthy and sustainable food production and consumption system
B. SMEs and smallholders (e.g., farmers)	Increased market competitiveness due to: ● Showcase project innovations ● Addressing the growing demand for plant-based products and aligning with current trends in consumers preferences. ● Availability of cheaper, healthier and easier to access plant-based products.	● Social media and project website ● Training webinars ● Visits to partners' labs and facilities
C. Policymakers	● Enhance standard harmonisation and foster a legislative implementation that could support a wider adoption of alternative protein products. ● Shaping policy recommendations.	● Policy leaflet ● Online Policy forum

D. Civil Society	● Train young professionals on innovative technologies ● Promotion of healthy lifestyle among the general society	● Participation to dedicated events (e.g. Researchers' Night) ● Educational games and online training materials for schools ● Living Labs in the Mediterranean countries ● Educational online training events ● Social media and project website

Plan for Dissemination, Communication and Exploitation activities

FEED Dissemination and Communication Plan (DCP) describes the project's target audience groups and explains how those groups are integrated into the project's dissemination and exploitation strategy to maximise the project's impact. In parallel, the DCP plan discusses the project communication strategy, designed to work in harmony with the dissemination and exploitation actions. The DCP will aim to:

- Define a strategy to provide an integrated, solid and common public image of the project, to be effectively recognisable by target audiences;
- Define specific messages, content and communication channels to ensure the visibility of the project's actions, activities and events;
- Ensure ongoing communication flow between project partners, stakeholders and end-users;
- Identify KPIs to assess the efficiency of proposed measures and adoption tools for daily monitoring of communication actions;
- Consider expert and end user feedback, outcomes of socio-economic assessment and policy alignment and inputs from the co-creation event with other EU projects to adjust the communication and dissemination strategies;
- Increase the awareness about the project activities and its conclusions, disseminating extensively the results of the project to policy makers, the research community, the general public and businesses.
- Guarantee the long-term impacts of the project through the design of events, workshops, and the direct involvement of the target audience.

Table 2b. Dissemination activities of the FEED project

Dissemination plan			
Tools	**Objective**	**TG***	**KPIs**
Scientific articles and publications	Contribute to the knowledge base generation. Facilitate the uptake of project results.	A	≥5 publications in peer-reviewed open access journals
Technical publications		B, D	≥ 5 technical articles in sectoral magazines
Networking events with other funded projects	Discuss best practices and identify synergies. Maximise the communication and dissemination effort	A	1 Networking section in project website At least 2 projects involved in these networking activities
Training activities for SMEs and smallholders	Showcase FEED products and their properties. Training on FEED innovative technologies.	B	2 training webinars on the specific project technologies involving at least 20 participants each

Online Events	Increase consumers' awareness on specific topics related to the project, such as "how can we be more sustainable when purchasing and consuming food products?"	A, D	1 international youth training 1 webinar for each theme will be organised in English and will be open to any MED and EU country. Some of these webinars will be replicated in different languages to engage more by removing the language barrier.
Promote new policy	Discuss FEED implementation with policymakers and their contribution to support the adoption of legume-based food products through dedicated policy tools.	C	1 Policy leaflet 1 Online policy forum
Final event	Widely disseminate the project results at the final FEED conference organised physically (preferably) by the end of the project.	ALL	1 final conference with at least 100 participants.
Educational Games and e-manuals	Increase social awareness on the impact of our diet on the environment.Educate youngsters and adolescents through non-formal education methods and tools on the importance of a healthy diet.	D	Two different versions of this game will be developed, for two age groups: 6-12 and 14-24. E-manual for secondary school teachers and/or youth trainers will consist of 5 different education modules.
Living- Labs	Promote the consumption of plant-based products. Disseminate project results on a large scale in different Mediterranean countries.	A, B, C	These living labs will consist of face-to-face play one-hour sessions of groups of about 20 children. A minimum of 16 play sessions will be carried out (four play sessions by participant country: Spain, Italy, Croatia and Tunisia), foreseeing a participation of at least 320 children.

*TG= Target Group as indicated in Table 2a.

Exploitation Strategy and Intellectual Property Rights

Aligned and coordinated with communication and dissemination activities, the exploitation strategy will aim at preparing the ground for the use of the innovative technologies and products developed by the projects, triggering impact and interest among relevant stakeholders. Being a RIA with a low final TRL, the **FEED Exploitation Strategy** will lay the foundations for the future implementation of the project at a larger scale, identifying outcomes that can be considered as potentially exploitable and those that exhibit protectable Intellectual Property Rights **(**IPR) to help foster the transition from R&D to market implementation. A draft of this preliminary exploitation strategy will be included into an updated version of the Dissemination and Communication Plan (M6). The commercialization of the FEED products will not take place within the duration of the project. However, the leading group of each country involved in FEED will prepare a specific list of the potential interested SME to be invited at specific activities organised by the project (WP9) and at the final event of the project. On this latter occasion, FEED products will be promoted for a potential launch to the market. Based also on the activity carried out in WP5 regarding the evaluation of the sensory properties of the food products developed, a follow-up period will be organised by the coordinator to track the chance of FEED products to be used in an already known brand that will increase the possibility of FEED to enter the market.As a consistent part of the Exploitation Strategy, the project **IPR strategy** ensures that partners can adequately protect and fully exploit their project results, while preventing conflicts

and ensuring fair ownership. The IPR strategy includes: i) IP assessment, with an analysis of national and institutional rules and of the background knowledge; ii) ownership and exploitation of the foreground knowledge; iii) publication of results and the process for the release of publications to find an acceptable balance between protection and publication needs; iv) the definition of IP; v) IPR issues within the consortium, such as licensing of background and foreground IP. A simple invention disclosure template will be provided to all partners, helping them to evaluate protectability of foreground knowledge and facilitate communication and discussions around it. The following principles will be followed regarding **foreground IP issues:** i) each partner is responsible for taking the appropriate steps for securing IP of the knowledge, results, tools etc. which can be commercially or industrially exploited; ii) results generated in the technical field of a partner shall be owned by the partner who generated them; iii) in case of jointly generated results between partners, the joint owners are entitled to use their jointly owned results for non-commercial research activities on a royalty-free basis. In this case, patenting costs will be split between the applicants and a division of rights will be agreed based on the different contributions of the partners/inventor; v) access rights to results for internal research activities shall be granted on a royalty-free basis. ITB will be responsible for drafting the general Exploitation Strategy in the context of task 9.2 and leading the Exploitation and Innovation Task Force, including at least one representative per partner.

FEED strategy for knowledge management and protection: FEED adheres to EU Open Science (OS) principles, fostering a transparent, accountable, inclusive, fair and effective scientific innovation: i) by sharing knowledge, data, and tools as early as possible in the R&I process; and ii) by open collaboration with all relevant knowledge actors. Throughout the project, the following OS practices will be implemented, guided by the "as open as possible, as closed as necessary" principle.

Open access to research outputs such as publications, data, and workflows. Once papers are published, FEED will ensure open access, depositing them in a trusted repository and providing open access without delay under CC BY or equivalent licence together with the information needed to validate their conclusions. Technical papers will be published in peer-reviewed open access journals (''gold'' open access) or self-archiving manuscripts (''green'' open access). Publishing in Open Research Europe (ORE) will be also considered, as it provides an easy, high-quality peer-reviewed venue to publish papers open access, at no cost, in full compliance with the EC's open access policies. Authors of the publications will retain sufficient Intellectual Property Rights (IPR) to meet the open access requirement.

-*Measures to ensure reproducibility of results.* FEED is committed to transparency and will consistently, carefully, and thoroughly document and share as much information about the actual research process as feasible.

-*Open collaboration within science and with other knowledge actors, including citizens, civil society and end-users, such as in citizen science.* Educational materials (e.g. presentations, posters, figures, and movies) and social media will be open for comments with the aim of collecting feedback and fostering discussion. End users will be involved through consumers' surveys and focus groups as well as events and webinars open to society. Open collaboration within the scientific community and industrial stakeholders will be ensured via joint activities with other funded projects.

All project partners have agreed to open access principles, as defined in Directive 2019/1024 of the European Parliament on open data and the re-use of public sector information.

Data Management Plan: FEED will generate a lot of data, including product characteristics, product formulation, process parameters, consumer analysis, sensory analysis, etc. The FEED project will develop a Data Management Plan (DMP) aimed at defining an effective data and project output management strategy in compliance with FAIR principles. The DMP is a living document that will be generated at M6 in the context of Task 10.3 and updated over the lifespan of the project, focusing on: i) identification of all the data collected and handled during the project; ii) whether and how they will be used, shared and exploited; iii) how and under which conditions data will be curated, preserved and shared; iv) how data and project outputs will be accessible and interoperable regarding specific quality standards; v) estimation of costs related to Data Management.

To ensure **findability**, data, research outputs and metadata will be deposited in a trusted general repository (e.g. Zenodo) compliant with EU requirements by consulting the OpenDOAR tool. Data will follow standardised nomenclature codes, formats and vocabularies (e.g. DOI). Furthermore,

FEED seeks to make research data openly available and **accessible**, whenever possible, to allow dissemination, validation and reuse of research results. Data will be thus "as open as possible, as closed as necessary" according to open access principles, while being protected, if needed, by the IPR strategy. A data availability statement will be associated with project outputs, enabling the reader to understand where and how the data will be available. **Interoperability** will be ensured by describing all datasets with standard metadata, converting data in well-known and documented open formats; all relevant documentation explaining codebooks, users' manuals, data collection procedures and analysis will be made available along with the data the chosen data repositories will support protocols for the interoperability of metadata. Finally, to facilitate the **reuse** of data, datasets will be made available, unless otherwise specified, under Creative Commons licence (CC-BY). All sensitive data will be treated according to the General Data Protection Regulation (GDPR).

(a)Communication activities: Communication activities, carried out in WP9, will ensure that relevant actors and stakeholders are engaged in a two-way dialogue with the project. All consortium members will be involved in FEED communication activities.

Table 2c. Communication activities carried out within the FEED project

Communication activities			
Tools	**Objective**	**TG**	**KPIs**
Project Website	• Raise awareness on project goals • Stay update on progress and showcase results • Advertise project events and initiatives • Keep stakeholders engaged with the community actions	ALL	Visitors (year) ~ 10.000
Social Media (LinkedIn, Facebook, Twitter)			Follower ~ 3000 Posts/month ≥ 2
Communication kit	• Raise awareness on project goals and benefits. • Show the opportunities to every target group (academia, consumers and industries). • Make the project recognizable	ALL	• 1 project logo • 1 project roll-ups • 1 project brochures translated at least in three different languages • ≥5000 brochures distributed in digital and printed form
Webinar	• Update the public audience and all stakeholders on project implementation • Promote debates and opinion exchanges • Identify barriers in the adoption of plant-based products in different cultural and socio-economic context	ALL	2 with ≥ 80 participants in total

3. Implementation

3.1 Work plan — Work packages, deliverables

As described in the Methodology section, FEED will consist of 10 WPs. These are summarised in Table 3.1a. WPs are explained in details Table 3.1.b and deliverables are summarised in Table 3.1.c.

Table 3.1a: List of Work Packages

WP #	**WP Title**	**Lead Participant #**	**Lead Participant short name**	**Person-Months**	**Start Month**	**End Month**
1	Sprout production from different plant species	5	ARO	25	1	36
2	High throughput screening regarding bioactive compounds, antioxidant activity, and antinutritional compounds of different sprouts	1	CNR	42.5	3	30

3	Experimental models: advanced *in vitro* and *in vivo* models to validate beneficial selected sprouts-host interaction	1	CNR	44	12	36
4	Development of edible coatings and biodegradable active-packaging	10	BGT	63	1	36
5	Quality characteristics and shelf-life of packed products	2	CREA	19	15	36
6	Microencapsulation of bioactive compounds for use as food ingredients	9	ATÜ	28	8	36
7	Production of snacks and/or cooked food containing the selected healthy sprouts	7	UNIZG	37	12	36
8	Consumer acceptance and social awareness	5	AIJU	43.5	24	36
9	Communication and dissemination	3	ITB	30.5	1	36
10	Management & Coordination	1	CNR	17	1	36
		Total Person-Months		349.5		

Table 3.1b: Work Package Descriptions

# WP	**1**	**Lead beneficiary**					**ARO**			
Sprouts production from different plant species										
#	1	2	3	4	5	6	7	8	9	10
Name	CNR	CREA	ITB	CSIC	AIJU	ARO	UNI ZG	Argonauta	ATÜ	BGT
PM	12	0	0	0	0	13	0	0	0	0
Start month: 1					**End month: 36**					
Objectives:										
-to select specific wild and cultivated species for sprouting -to set-up the best growing condition and light treatments -to transfer the sprout growing technology to a specialised factory for a pilot-scale sprout production										
Task 1.1 Production of sprouts from different species, cultivated or spontaneous										
CNR and ARO will focus on the production of sprouts from different plant species both wild/spontaneous and cultivated. The choice of the species will be supported by a deep literature review on the metabolic characteristics of plant species suitable to sprouting. Among the cultivated species: flax (*Linum usitatissimum* L.), Azuki red (*Vigna angularis* L.), Azuki green (*Vigna radiata* L.), basil (*Ocimum basilicum* L.), carrot (*Daucus carota* L.), cauliflower (*Brassica oleracea* L. var. *botrytis*), broccoli (*Brassica oleracea* L. var. *italica*), alfalfa (*Medicago sativa* L.), onion (*Allium cepa* L.), garlic (*Allium sativum* L.), quinoa (*Chenopodium quinoa* Willd), soybean (*Glycine max* L.). Spontaneous species: Trigonella (*Trigonella fòenumgraecum*), radish (*Raphanus raphanistrum* L.), purslane (*Portulaca oleracea* L.), Amaranthus sp., clover (*Trifolium pratense* L). In this context ARO, based on a preliminary screening of >30 wild species from Israel as potential sources for edible sprouts, selected two species for further exploration: (1) Milk thistle (*Silybum marianum*; an edible weed rich in antioxidants, primarily silymarin, a unique complex of flavonoids, and used as a traditional medicine for liver diseases), and (2) White mustard (*Sinapis alba*; a wild herb rich in anti-inflammatory compounds, primarily glucosinolates). The sprouts will be grown under different lighting conditions of full light, full darkness and full darkness followed by short exposure to light, in an attempt to enhance production sprout biomass and content of active ingredients.										
Task 1.2 Pilot-scale sprouts production										
ARO will sub-contract Al Alim Medicinal Herb Center Ltd. and Udi's Sprouts for sprouts growing. Once the optimal growth and lighting conditions are established for both species (white mustard and										

milk thistle) by the ARO researcher, a pilot scale sprouts production will be performed at the facility of Udi's Sprouts in collaboration with Al Alim Medicinal Herb Center Ltd. The fresh sprouts will either be frozen or freeze-dried for further analysis of content of active metabolites (WP2).

Description of Deliverables:

D1.1 Report on the production of selected sprouts for chemical extracts (**M12**)
D1.2 Protocol on optimised sprout production under different lighting conditions (**M30**)
D1.3 Pilot- Scale sprouts production (**M36**)

WP #	**2**	**Lead beneficiary**					**CNR**			
High throughput screening of bioactive compounds of different sprouts										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Name	CNR	CREA	ITB	CSIC	AIJU	ARO	UNI ZG	Argonauta	ATÜ	BGT
PM	16	5	0	11	0	10	0	0	0	0.5
Start month: 3					**End month: 30**					

Objectives:

-To determine the health benefits (main classes of antioxidant metabolites, *in vitro* antioxidant activity, *in vitro* immuno-modulation and *in vitro* prebiotic effects) of the sprouts produced in WP1;
-To select the most health-promoting sprouts;
-To conduct a sensorial characterization of fresh sprouts
-To conduct a metabolite profiling analysis for the bioactive compounds in the produced sprouts

Task 2.1 Determination of main bioactive metabolites, antioxidant activity and antinutritional compounds

This task will focus on the extraction and first rapid high throughput screening of the main classes of secondary metabolites of the sprouts produced in WP1. In particular a general characterization of total phenols, flavonoids, anthocyanins will be carried out on ethanolic sprouts extracts. Then, more specific hydrophilic antioxidants (such as ascorbic acid, glutathione, total phenols), and lipophilic antioxidants (carotenoids) will be measured. Ascorbic acid and glutathione will be determined by HPLC, total polyphenols and carotenoids content will be determined by spectrophotometric assays. In the same extracts, *in vitro* antioxidant activity will be evaluated through DPPH and Electron Paramagnetic Resonance (EPR) analysis. For a complete characterization of the sprouts the content of antinutritional compounds (i.e. phytic acid, trypsin inhibitor) will be determined. In vitro tests for i*n vitro* immuno-modulation (epithelial cell lines and also, NF-kB reporter cell models including HEK-TLR4-NFkB), *in vitro* prebiotic effects (effects on growth of the potential health-related bacteria as *Bifidobacterium* spp.) will be carried out. After a complete evaluation of the above described parameters the 10 best performing species will be subjected to a more deep chemical characterization (Task 2.3). Depending on the isolated amount and bioactivity, at least one sprout extract will be delivered to WP4 (BGT) for microencapsulation.

Task 2.2 Sensorial characterization of fresh sprouts

In order to define the best sprouts to be selected for fresh consumption, sensorial characteristics, such as colour and texture, will be instrumentally evaluated. Specifically, colour parameters (L*, a*, b*) will be measured by means of a Spectrophotometer CM-2600, and texture will be assessed by means of the most suitable mechanical compression test by Texture Analyzer. In parallel, the sensorial characteristics (appearance, aroma, texture, odour) of sprouts will be judged by a panel of trained testers using a descriptive test. This WP will provide information about the consumer acceptability, and the results will be used to differentiate between sprouts intended for fresh consumption (WP5) and those which will be used for the production of lyophilized powder. Lyophilized powder will be used as a food additive in WP6 and for the production of snacks and cooked food in WP7.

Task 2.3 Sprouts deep chemical characterization

The best-performing sprouts will undergo a deep chemical characterization through Mass-spectrometry and NMR to identify and quantify the healthy compounds present in the sprouts (CREA). The metabolite profiling of selected sprout extracts will be evaluated by LC-MS and NMR, with the aim to detect a wide range of compounds. The crude extracts will be investigated by LC-UV

to obtain separation and quantitation of the different metabolites; LC-MS analyses will be then performed for the identification of the compounds in the complex mixtures. The whole extracts and purified compounds will also be investigated by high resolution 1H and 13C NMR spectroscopy through multi-dimensional omo- and hetero-nuclear NMR experiments to assess the presence of new compounds.

Description of Deliverables:

D2.1 Report on the antioxidant potential and sensory evaluation of the 20 sprout species (**M18**)
D2.2 Report on the study of LC-MS and NMR profiles of the 10 selected sprout species (**M36**)
D2.3 Detailed report on chemical composition, bioactives and antinutritional factors of the 10 selected sprout species (**M36**)

WP #	**3**	**Lead beneficiary**	**CNR**

Experimental Models: advanced *in vitro* and *in vivo* models to validate beneficial selected sprouts-host interaction

#	1	2	3	4	5	6	7	8	9	10
Name	CNR	CREA	ITB	CSIC	AIJU	ARO	UNI ZG	Argonauta	ATÜ	BGT
PM	24	0	0	20	0	0	0	0	0	0

Start month: 12 **End month: 36**

Objectives:

-*Ex vivo* and *in vitro* screening of the sprouts potential beneficial effects (Anti-oxidant, in human blood cells and anti-inflammatory *in vitro* system)
-*In vitro* Rapid/screening of the sprouts potential beneficial effects (*in vitro* microbial modulation and host response by culture cell models)
-Definition of requirements, preparation and characterization for the animal study: identification of the specific sprouts
-Impact of the specific sprouts on intestinal microbiota and relative metabolic profile:preclinical study

Task 3.1 *Ex-vivo* antioxidant activity and in vitro anti-inflammatory effects

The health benefits of selected sprouts will be measured by *ex vivo* antioxidant activity using tests on human red blood cells (CAA-RBC), with the aim of also predicting their bioavailability. The anti-inflammatory properties of the selected sprouts will be identified by measuring the selective cyclooxygenases (COX) inhibitory activity that could provide potential benefit of sprouts. Indeed, COX are the target enzymes for nonsteroidal anti-inflammatory drugs and *in vitro* assays are able to support a rapid screening.

Task 3.2 *In vitro* models for gut microbial modulation and host response

For the *in vitro* screening mimicking the human gut, two approaches will be used:
a) *In vitro* colonic fermentation. Faeces from the healthy volunteers will be used as inoculum in a basal medium (10% v/v) and stabilised in anaerobic conditions at 37°C for 4h. After stabilisation, faecal slurries will be supplemented with selected sprouts preparations. After incubation following the protocols, bacterial pellets and supernatants will be collected and used for metabolites and microbiota analysis (Task 3.4).
b) Intestinal *in vitro* cell models. A combination of epithelial (Caco-2) and goblet-like cells (HT-29MTX or LS174T) and differentiated THP-1 cells (macrophage-like) will be exposed to sprout preparations. Intestinal permeability will be measured by TEER and also, with fluorescent markers (luciferase yellow). Supernatants will be collected to determine specific cytokines (IL8, IL10, IL6 etc). RNA and proteins will be obtained for downstream analysis including targeted Gene expression by qPCR (specific genes and housekeeping genes will be selected according to data previously obtained, which would include zonulin, mucin MUC1 and some cytokine genes such IL18, IL10 etc).

Task 3.3 I*n vivo* model

Specific changes in gut microbiota profiles associated with a specific diet containing the selected sprouts will be evaluated to verify a possible positive effect of sprouts on gut health in animal models. To test the prebiotic role of selected sprout preparations (sSP) on gut microbiota we will use an animal model in particular F344 rats aged 7 weeks (12/group) treated with 4 different sSP. Rats will be fed for two months with the 4 sSP. A control group will be carried out in parallel following normal weaning. Every week, body weight, food and water intakes will be determined and faeces and urine collected for analysis of metabolites and microbial communities (bacteria/fungi). After 2 months, animals will be then sacrificed and the intestinal tissue (colon mucosa and ileum) will be analysed to evaluate the immune response to the sSP and the adherent microbiota to the mucosa, to assess the anti- or inflammatory potential of the microbial component.

Task 3.4 Identification of the faecal microbial communities (Bacteria and Fungi) and relative Metabolomics profiles

Faecal microbiota profiles will be analysed by two approaches: a) Specific amplicon sequencing approach: total microbial DNA will be extracted from faeces and colon mucosa using repeated bead-beating. The V3-V4 hypervariable regions of the 16S rRNA gene for bacteria and the ITS1-4 for fungi will be sequenced by Illumina MiSeq platform. The bioinformatics analysis will be performed. b) Specific qPCR: to quantify specific bacterial species associated to specific sSPs (i.e *Bifidobacterium, Lactobacillus, Bacteroides* etc.) deriving from amplicon sequencing analysis, we will use specific qPCRs to follow the evolution of these bacterial species over time, in *in vivo* & *in vitro* model*s*.

Description of Deliverables:

D3.1 A overall health analysis (antioxidant and anti-inflammatory) report for the selected sprouts (**M34**)
D3.2 Report on the selected sprouts impact on *in vitro* microbiota and *in vitro* host response (**M36**)
D3.3 Report on the specific sprouts effects on intestinal microbiota and relative metabolomic profiles in the preclinical study performed on animal model **(M36**)

WP #	**4**	**Lead beneficiary**					**BGT**			
Development of edible coatings and biodegradable active packaging										
#	1	2	3	4	5	6	7	8	9	10
Name	CNR	CREA	ITB	CSIC	AIJU	ARO	UNI ZG	Argonauta	ATÜ	BGT
PM	30	0	0	0	0	0	0	0	2	31
Start month: 1					**End month: 36**					

Objectives:

- To develop polyester, polysaccharide and/or protein-based formulations of natural active agents to be applied as edible coatings for sprouts;
- To develop biobased and biodegradable microcapsules containing natural active agents to be used as active coatings in thermoplastic packaging films;
- To manufacture and characterise active biodegradable films for sprout packaging.

Task 4.1 Biopolymer formulations for edible coating and preparation of blank microcapsules

Lack of processability limits the application of protein and polysaccharide-based biopolymers in the food packaging industry. However, in order to apply these biopolymers in the packaging segment, one of the most common techniques is edible coatings. In this technique, a thin layer of edible polymer is applied to the surface of the food or inner side of the packaging material to improve the quality of products via shielding them from natural deterioration processes due to oxidation, moisture absorption/desorption, oils, gas, or via vapours barrier management, and antimicrobial agents. In this regard, proteins such as Corn Zein, Whey Proteins, and Soy Protein, because of their wide range of degradability, low price, availability, and hydrophobic nature can be promising biopolymers used as a carrier of active agents and coating of the Sprout packaging. The scope of this WP includes integrating novel antibacterial and antioxidant active agents into the bio packaging material to reduce the microbial contamination of sprout products. For this purpose, in the first stage, in compliance with the EU strategy on Plastic Recyclability and Biodegradability and the European Food Safety

Authority (EFSA), the list of substances that can be used in contact with food, microcapsules, and thermoplastic films will be fabricated based on naturally occurring polymers. In particular, polysaccharides and proteins-based compounds (zein, pectin, alginate, chitosan, etc.) will be selected as potential biodegradable polymers for capsule formation. Moreover, some polyester-based degradable biopolymers such as poly(lactic acid) and polybutylene succinate will be tested for the preparation of microcapsule. In this task, BGT will investigate different techniques such as coacervation, precipitation, spray-drying, single or double emulsion, and microfluidic for manufacturing the microparticles. In addition, physicochemical and morphological analyses will be performed, in cooperation with CNR, to characterise the particles. Finally, the most promising protocol and biopolymers will be selected for the formulation of at least 3 types of microcapsules.

Task 4.2 Microencapsulation of bioactive natural agents

In this task, different active secondary compounds (the most active and proper sprout extracts selected in WP2, as well as commercially available references), will be used by BGT as antimicrobial and antioxidant agents to be encapsulated into the biopolymers according to the procedures selected in T4.1. The critical and influential parameters that will be considered for the microparticles are the highest loading efficiency, microparticle bioactivity, developed concept, specific formulation process, and experimental setup parameters. The formulated microparticles will be characterised by BGT and CNR according to different aspects: the physicochemical and thermal analysis (FTIR, NMR, UV-Vis spectroscopy, TGA and DSC) will allow assessing the active agent encapsulation and drug loading efficiency, the morphological analysis by SEM will be used for the particle size study. Finally, release studies through UV-VIS or HPLC will measure release rate and time, and bioassays will confirm the activity of the active agent after encapsulation. Finally, at least 2 types of bioactive microparticles will be selected to be incorporated in the thermoplastic films.

Task 4.3 Development of edible coatings and active packaging

Once the optimal formulations have been identified, laboratory-scale development of edible coatings by dipping or spraying onto sprouts will be tackled (BGT). Besides, the incorporation of the particles in the thermoplastic films will be carried out. Surface immobilisation by spray or layer-by-layer coating or incorporation by blending and extrusion will be investigated to select the most convenient technique for producing an active packaging system (CNR). Active packaging characterization, loading efficiency, and release rate will be assessed by thermal analysis (DSC and TGA), FTIR, and X-ray diffraction (XRD). The particle size, surface potential, and particle density will be studied by dynamic light scattering (DLS), optical and electron microscopy, and Energy Dispersive Spectroscopy (EDS). Furthermore, the mechanical characteristics will be measured. Characterization of coated and packaged sprouts will be performed in WP5.

Description of Deliverables:

D4.1 Report on the development of biopolymer-based microcapsule suitable for edible coating and active metabolites formulation (**M13**)
D4.2 Manufacturing and characterization of active agent-loaded microcapsules (**M26**)
D4.3 Manufacturing and performance evaluation of biodegradable active coated films for sprout packaging (**M36**)

WP #	**5**	**Lead beneficiary**					**CREA**			
Quality characteristics and shelf-life of packed products										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Name	CNR	CREA	ITB	CSIC	AIJU	ARO	UNI ZG	Argonauta	ATÜ	BGT
PM	4	15	0	0	0	0	0	0	0	0
Start month: 15					**End month: 36**					

Objectives:

- to perform shelf-life analysis of selected sprouts
- to optimise MAP parameters for sprouts quality preservation
- to select the most effective innovative packaging in extending sprouts shelf-life
- to test the efficacy of edible coatings on sprouts shelf-life

Task 5.1 Effect of modified atmosphere packaging on quality characteristics

Sprouts still maintain vigorous metabolic activities after harvest, which makes them easy to lose water and induces a rapid qualitative decay. Moreover, operations of handling cause stress to tissues, triggering oxidative browning, rapid loss of sensory attributes such as consistency and nutritional degradation. Post-harvest techniques such as modified atmosphere packaging (MAP) are very useful for extending the shelf life of ready-to-eat products. In this task, the influence of packaging atmosphere on quality maintenance of sprouts throughout shelf life will be evaluated. To this aim, two packaging methods (*passive* and *active* modified atmosphere) will be compared in order to select the best condition to reduce quality deterioration during the sprout distribution. To this aim samples will be previously sanitised and dried before being packed and stored at 6°C for at least 7 days. Quality parameters will be measured at different time-points. Quality considerations are largely based on appearance. Colour parameters (L*, a*, b*) will be measured by means of a Spectrophotometer CM-2600. Texture will be assessed by means of mechanical compression tests using a Texture Analyser. Moreover, common quality parameters, such as the total soluble solids content, pH and total titratable acidity will be determined. The impact of modified atmosphere on nutritional quality will be assessed by measuring the content of bioactive metabolites (hydrophilic and lipophilic antioxidants) and their *in vitro* antioxidant activity (e.g., DPPH, superoxide anion quenching capacity, by EPR). The progress of sprouts senescence will also be estimated by membrane integrity analysis (e.g., relative water content, electrical conductivity and TBARS assay). In addition, the influence of MAP on the regulation of polyphenol biosynthesis will be evaluated through the measurement of phenylalanine ammonia-lyase (PAL) activity, the key enzyme in the production of plant phenolic compounds. The off-flavours development will be monitored using two approaches: the use of electronic nose, that will be applied directly on the bag to evaluate any possible variation of the atmosphere profile, and the measurement of fermentation products, such as ethanol and acetaldehyde, which will be measured by gas chromatographic technique. At each time-point, samples will be subjected to microbial analyses: sprouts will be blended in the homogenizer with 0.1% sterile peptone water, then they will be properly diluted and used for quantitative estimation of the total bacterial, yeast and mould count on appropriate culture media (e.g. Nutrient agar, Mac-Conky agar and DRBC agar). Finally, the sensory properties of the products will be also monitored by a panel of about 10 trained judges to verify any differences at the time of consumption. Descriptive and triangle tests will be properly organised.

Task 5.2 Effect of innovative packaging on quality characteristics

The effect of active biodegradable films developed as part of the WP4 -Task 4.3, in maintaining the quality of sprouts will be assessed. At least two selected active films will be evaluated and compared to a reference BOPP film for their ability to extend the shelf-life of sprouts. As the possible different carbon and oxygen transmission rates of the coated films could influence the atmosphere inside the packages, CO_2 and O_2 concentrations will be carefully checked. Quality characteristics of packed sprouts will be evaluated based on the same analyses detailed in Task 5.1.

Description of Deliverables:

D5.1 Report on optimum modified atmosphere in preserving quality characteristics during sprouts shelf-life (**M30**)

D5.2 Report on optimum innovative packaging/coating in preserving quality characteristics during sprouts shelf-life (**M36**)

WP #	**6**	**Lead beneficiary**					**ATÜ**			
Microencapsulation of bioactive compounds for food ingredients										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Name	CNR	CREA	ITB	CSIC	AIJU	ARO	UNI ZG	Argonauta	ATÜ	BGT
PM	0	0	0	0	0	0	0	0	28	0
Start month: 8					**End month: 36**					

Objectives:

- To select the appropriate wall material combination.

- To determine optimum microencapsulation formulation.
- To determine optimum spray drying process conditions during the production of microencapsulated powders.
- To identify the storage stability of the microencapsulated powders.
- To investigate the potential of microencapsulated bioactive compounds as a food ingredient.

Task 6.1 Determination the appropriate wall material combination

Microencapsulation will be performed to convert the sprout extract, which has been determined to have high bioactive properties, into a food additive. The emulsion/spray drying technique will be used in the microencapsulation process. Emulsions (O/W or W/O/W) will be produced depending on the hydrophobic/hydrophilic nature of the bioactive components of the extracts, followed by spray drying. In the emulsion preparation, PGPR 4150 and/or Tween 20 will be used as emulsifiers according to the emulsion type. The bioactive compounds will be entrapped in the inner dispersed phase of emulsion whereas the wall materials will be used in the outer continuous phase of the emulsion. Different protein-carbohydrate combinations will be used as wall materials in microencapsulation and the appropriate combination will be determined. For this purpose, two different protein-based (sodium caseinate and whey protein concentrate) and three different carbohydrate-based (lactose, maltodextrin -DE 18- and gum Arabic) wall materials will be applied in combination in the continuous phase of the emulsion. After emulsion preparation, viscosity, droplet size distribution, turbidity and microscopic examination of emulsions will be done. Then, emulsions will be fed to the spray dryer and the microencapsulated powders will be produced. The powders' particle size distribution, physical properties (moisture content, water activity, bulk/tapped densities, wettability, surface fat content) and morphology will be investigated. Microencapsulation efficiency of powders will be measured and active compound concentration after *in vitro* gastrointestinal digestion will be determined. The most appropriate wall material combination will be determined using a multi-criteria decision analysis method, TOPSIS (The Technique for Order of Preference by Similarity to Ideal Solution).

Task 6.2 Optimization the microencapsulation formulation and spray drying conditions

The formulation (wall material concentrations and protein/carbohydrate ratios) and spray drying process conditions (inlet air temperature, feed flow rate and aspiration rate) will be optimised individually. Response surface methodology will be used in the optimisations. While a central composite rotatable design with two factors will be performed in the formulation optimisation stage, a three factor one will be applied in the spray drying optimisation stage. As in Task 6.1, the properties of the emulsions, the physical and microstructural properties of powders, the microencapsulation efficiency, and the bioaccessibility of the bioactive components will be investigated during optimisation studies. Optimum formulation and spray drying conditions will be determined using the desirability function method.

Task 6.3 Investigation the storage stability of the microencapsulated bioactive compounds

The storage stability of the final microencapsulated powder product will be determined. The adsorption isotherms of the microencapsulated powder will be analysed and the variations of quality characteristics such as physical properties, microstructure, microencapsulation efficiency, oxidation, volatile compounds, etc. will be investigated for 6 months of storage.

Task 6.4 Production of drinkable yoghurt "Ayran" and Turkish noodles "Erişte" using microencapsulated bioactive compounds

The potential of microencapsulated bioactive compounds for use as a food additive will be investigated. In this context, 2 different traditional Turkish foods, a drinkable yogurt "Ayran" and Turkish noodles "Erişte", will be selected to demonstrate the effects of microencapsulation on different food processes (fermentation/heat treatments). The composition, physical and chemical quality characteristics, and volatile profiles will be examined, and sensory analyses will be carried out. The bioaccessibility of the microencapsulated bioactive compounds in the food matrix will also be investigated by *in vitro* gastrointestinal digestion study.

Description of Deliverables:

D6.1 Obtaining microencapsulated sprout extract powder (**M30**)
D6.2 Report on the variation of quality properties of microencapsulated powder during storage (**M36**)

<table>
<tr><td colspan="11">D6.3 Functional drinkable yoghourt “Ayran” and Turkish noodles “Erişte” production (M36)</td></tr>
<tr><td>WP #</td><td>7</td><td colspan="5">Lead beneficiary</td><td colspan="4">UNIZG</td></tr>
<tr><td colspan="11">Production of snacks and jelly food containing the selected healthy sprouts</td></tr>
<tr><td>#</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>Name</td><td>CNR</td><td>CREA</td><td>ITB</td><td>CSIC</td><td>AIJU</td><td>ARO</td><td>UNI ZG</td><td>Argona uta</td><td>ATÜ</td><td>BGT</td></tr>
<tr><td>PM</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>37</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Start month: 12</td><td colspan="5">End month: 36</td></tr>
<tr><td colspan="11">Objectives:</td></tr>
<tr><td colspan="11">- Select plant material eligible for 3D printing and cooking
- Sprouts functional food production based on 3D-printing technology
- Application of sustainable non-thermal technologies in sprouts functional food production
- Sprouts functional food production based on cooking with gelling-agents</td></tr>
<tr><td colspan="11">Task 7.1 Select plant material for 3D printing and cooking</td></tr>
<tr><td colspan="11">Plant materials (e.g., fruits, legumes, agricultural wastes, etc.) will be selected based on their different chemical composition, such as the source of polyphenols, anthocyanins, carotenoids, chlorophylls, and other bioactive compounds. In addition, plant sources with higher pectin content will be selected because only viscous material can be considered for 3D printing. In addition, this type of plant material is also suitable for the production of jelly products since only products with a reduced sugar content will be prepared, which have a lower dry matter than conventional products and whose texture therefore depends on the plant material. Monitoring of the nutritional and biological value of selected plant sources will be performed by spectrophotometric and/or chromatographic analysis. Evaluation also will include in vitro antioxidant capacity testing through various scavenging activity assays, reducing power analysis, and testing for various radical scavengers.</td></tr>
<tr><td colspan="11">Task 7.2 Production of 3DP snacks based on sprouts and their physicochemical, nutritional and sensory characterization</td></tr>
<tr><td colspan="11">After selecting the plant matrix for 3D printing, the addition of different types and proportions of hydrocolloids (e.g., starch, pectin, etc.) to the mixture will be tested to determine its suitability for achieving the desired viscosity. Foodini Natural Machines (Barcelona, Spain) will be used to implement the 3D printing technology for production of 3DP snacks based on sprouts. Depending on the viscosity of the prepared mixture, different geometries and shapes as well as 3D printing programs will be tested depending on the nozzle size (0.5-10 mm), printing speed (200-50000 mm/min), flow rate of ingredients (0.1-50 mm/min), nozzle height of the first layer (0-100 mm) and line thickness (0.4-10 mm) to find optimal conditions for the production of 3DP snacks. After selecting the optimal proportion of a suitable carrier, as well as the program for 3D printing with respect to the studied process parameters, the operating conditions for the addition of sprouts either fresh or processed will be examined in order to find optimal proportion (%) with respect to the desired quality characteristics of the 3D printed product. For all products, the physicochemical properties (e.g. soluble solids content, pH, etc.), sensory properties (by using Quantitative Descriptive Analysis), and the content and composition of bioactive compounds will be determined using spectrophotometric and/or chromatographic methods. In addition, antioxidant capacity will be investigated using various in vitro radical scavenging activity assays, reducing power analysis, and tests for different radical scavengers. Microbiological analysis of raw materials and finished products will include the determination of aerobic mesophilic bacteria, enterobacteria, yeasts and moulds, sulfite-reducing clostridia, S. aureus, and the presence of L. monocytogenes and Salmonella spp. by classical microbiological isolation methods on selective substrates according to ISO.</td></tr>
<tr><td colspan="11">Task 7.3 Evaluation of selected sustainable non-thermal technologies in terms of quality assurance of 3DP products and higher biological potential of final products</td></tr>
<tr><td colspan="11">Sustainable non-thermal technologies (e.g., High Power Ultrasound (HPU) and/or High Intensity Pulsed Electric Field (HIPEF), etc.) will be used to investigate their effectiveness in extending the shelf life of 3D-printed and or cooked functional snacks. These technologies can be used to pre-treat the plant material prior to processing to increase its bioactive potential and ensure microbial stability</td></tr>
</table>

during storage. The UP400St, 400 W, 24 Hz ultrasonic processor (Hielscher Ultrasonics GmbH, Germany) will be used for HPU pretreatment. Operating conditions to be investigated include variations of: (i) amplitude (0-100%), (ii) pulse (0-100%), and (iii) treatment time (0-15 min). For HIPEF pretreatment, the HVG60/1 HIPEF device (Impel d.o.o., Zagreb, Croatia) will be studied at different (i) electric fields (0-50 kV/cm), (ii) frequencies (0-200 Hz), and (iii) treatment times (0-15 min). The nutritive and bioactive potential as quality indicators for the treated plant matrices will be monitored by spectrophotometric and/or chromatographic methods and *in vitro* antioxidant assays. Microbiological quality assessment will be performed as described in Task 7.2. For all tested technologies, multifactorial analysis and mathematical modelling will be used to find the optimal pretreatment parameters with respect to the output quality parameters.

Task 7.4 Production of jelly products with added sprouts and their physicochemical, nutritional and sensory characterization

To increase the potential of using sprouts in the production of functional foods, the possibility of producing jelly products based on fruits with the addition of fresh or processed sprouts will also be studied. In order to find the optimal formulation for jelly products, it is necessary to test different types and proportions of added pectin. For this purpose, pectins with a degree of esterification lower than 50% (e.g. low methoxyl pectin, low methoxyl pectin, amidated pectin, etc.) will be tested. As jelly products will be made with lower sugar content, i.e., lower energy value, the proportions of all added ingredients must be determined so that the finished product has adequate texture and firmness to minimise the syneresis effect during storage. Cooking will be performed in stainless steel vessels at atmospheric pressure with constant stirring. As with 3D-printed functional products, jelly products will be tested for nutritional and biological quality, as well as microbiological stability during storage, as described earlier.

Description of Deliverables:

D7.1 Realisation of 3DP functional snacks with added sprouts (**M25**)
D7.2 Realisation of functional jelly products with added sprouts (**M34**)
D7.3 Detailed report on the physicochemical composition, nutritional and sensory characterization of 3DP snacks and jelly products (**M36**)

WP #	**8**	**Lead beneficiary**					**AIJU**			
Consumer acceptance, social awareness, and carbon footprint										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Name	CNR	CREA	ITB	CSIC	AIJU	ARO	UNI ZG	Argonauta	ATÜ	BGT
PM	0	0	7	0	27.5	0	0	9	0	0
Start month: 8					**End month: 36**					

Objectives:

- To define the requirements of different consumer profiles using personas technique related with the project approach.
- To reach a better knowledge about the most effective communication strategies to provoke a change in the consumers' diet behaviour according to their lifestyle
- To develop a consumer perception evaluation about the initial concept of the prototypes
- To develop MED-based educational games and e-manuals based on scientific evidence in order to increase social awareness about MED benefits.
- To assess the carbon footprint of a few selected FEED products.

Task 8.1 Consumer acceptance

Different variables will be analysed in each study as: Gender, age, location and social class representation and differences. Among its facilities AIJU counts with a consumer database of more than 9.000 families (7.000 children). The statistical analysis of the results will consider the stratification of the sample by geography, gender, education and income, among others.
Task 8.1.a. User requirements: This task is aimed to gather the information required to understand the consumer behaviour related to their diet and their acceptance of the prototypes. To that end, the

following studies will be carried out: (i) a quantitative study in one MED country (electronic test with more than 500 interviews) (ii) 20 deep interviews in at least three MED countries.
Task 8.1.b. Validation/consumer acceptance: aims to collect valuable information about the developed prototypes related to comprehension (concept, idea and messages), price perception, buying intention, competitors' analysis (comparison with referent products available on the market, and initial value proposition and communication strategies validation. The following studies will be carried out: (i) A quantitative study in four MED countries (electronic test with more than 1200 interviews, 300 interviews by country); (ii) 20 deep interviews in at least three MED countries.

Task 8.2 Social Awareness

This project aims to increase the social awareness about the benefits of increasing the adherence to MED diet in general and to FEED products. To achieve these objectives different tasks will be performed in addition to general dissemination activities:
(a) Non-formal educational content development (Board Game development). A new game based on the most relevant project results will be developed to increase social awareness. This game will be produced in English language and translated into the other partners languages. Two different versions of this game will be developed, for two age groups: 6-12 and 14-24.
(b) E-manuals for secondary school teachers and/or youth trainers will consist of 5 different education modules promoting healthy diet behaviour and Mediterranean food modules should equip teachers/youth trainers to quickly prepare content on the topic and educate youngsters and adolescents through non-formal education methods and tools. Modules will include practical solutions and learning by doing methods. Modules will be tested as a pilot in 4 secondary and during 1 international youth training. (t.g. 14-18, 18-24). The objective of this task is to help youngsters and adolescents to shift towards Mediterranean healthy dietary behaviours increasing their awareness of the general benefits of the Mediterranean diets by producing, testing and disseminating e-manual for secondary school teachers and youth workers and trainers. (c) Living-Labs: expositions and workshops will be performed in two Mediterranean countries. In Spain it will be addressed to children between 6-12 y.o., and will be performed during 1 month at ANJU's Childlab (5.000 children/year). ARGONAUTA will be responsible for Croatia Living Lab. (d) Educational and training online events/webinars to increase consumers' awareness on specific topics related to the project, such as "how can we be more sustainable when purchasing and consuming food products?", "the importance of vegetable food for a more healthy diet", etc. One webinar for each theme will be organised in english and will be open to any MED and EU country. ITB will also organise a second webinar on each theme in Italian to engage more the country by removing the language barrier. Other partners will be invited to translate these webinars in their own language and organise these events targeting their own country. ITB will provide all the materials (such as agenda and slides) in English to be translated.

Task 8.3 Carbon footprint analysis

ITB will evaluate the carbon footprint of a few of the developed products (e.g. 2) selected on the basis of their technical properties (results obtained from WP5). This analysis will assess their environmental impacts by estimating any emission of the greenhouse gases which are converted into CO2 equivalent following the standardised parameters and calculations established by the Intergovernmental Panel on Climate Change (IPC) and the standard regulation UNI CEN ISO/TS 14067:2014. The analysis will be cradle-to-gate (from cultivation of sprouts to packaging), with partners providing data based on their findings. Secondary data from literature, market research and other documents may be used if necessary. The results of this analysis will highlight valuable information on process steps that need to be implemented to reach a more environmentally friendly product. Carbon footprint assessment also represents a winning marketing strategy for more aware consumers and can be used to support the communication and dissemination in WP9.

Description of Deliverables:

D8.1 Report on consumer behaviour and user requirements (**M24**)
D8.2 Report on consumer acceptance of prototypes (**M36**)
D8.3 MED Board Game prototype (**M36**)
D8.4 Publishing e-manual for secondary school teachers (**M36**)
D8.5 Carbon footprint analysis report (**M36**)

WP #	**9**	**Lead beneficiary**	**ITB**

Communication and dissemination										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Name	CNR	CREA	ITB	CSIC	AIJU	ARO	UNI ZG	Argonauta	ATÜ	BGT
PM	7	0.5	18	1	0.5	0.5	0.5	0.5	1	1
Start month: 1					**End month: 36**					
Objectives:										
-To ensure the maximum visibility and dissemination of the project outcomes to all project stakeholders and raise awareness about project results through tailored activities -To raise awareness among the public about the potential of using plant-based products -To guarantee the long-term sustainability of the project results by engaging a wide number of stakeholders										
Task 9.1 Dissemination to other stakeholders different than consumers										
This task organises project dissemination activities with the aim of maximising project impacts and ensuring the broad uptake of project results from all stakeholders (excluding consumers that are targeted in WP8). During the first months of the project, the Dissemination Plan, a living document highlighting the key messages, potential audiences, roles and responsibilities and methods of the dissemination activities, will be drafted. Target audience and related dissemination activities, as described in Table 2b, include: 1)Scientific community to spread the newly developed knowledge on sprouts cultivation, processing and healthy food production through publications possibly in open access peer reviewed journals, participations to scientific conferences and exhibitions 2) Other funded projects under similar topics to foster networking, knowledge and good practices exchanges through the organisation of get-to-know webinars and at least one online joint thematic event on healthy and sustainable food production and consumption system; 3) Policymakers to promote at policy level the wider adoption of plant-based products through the development of a policy forum and a policy leaflet. 4) SMEs and smallholders (e.g. farmers) to showcase project innovations through visits to partners' plants and facilities and dedicated webinars.										
Task 9.2 Communication										
This task aims to set up communication materials to inform, promote and communicate project activities and results to multiple audiences. The communication plan, defining project identity, communication channels and messages based on the target audience's needs, and the internal communication procedures, will integrate the dissemination plan (task 9.1) in the final FEED Dissemination and Communication Plan (DCP, D9.1) ensuring that communication actions work in harmony with the dissemination and exploitation strategy. In the context of this task, ITB will develop the FEED Exploitation Plan for a successful knowledge transfer and market implementation (see paragraph 2.2). The communication activities, detailed in Table 2c and further defined in the DCP, will include: 1) Communication kit (brochures, leaflets, posters, logo, templates) summarising the main project objectives and achievements to be distributed online and in the printed form at events; 2)Social media accounts with news on the projects and education info in a nutshell. Social media campaigns are foreseen to increase project visibility; 3)Project website and project newsletter to showcase project objectives and achievements, distribute project material, collect news, etc; 4)Participation in Citizen Science events (e.g. Researchers' night).										
Description of Deliverables:										
D9.1 Dissemination and Communication plan **(M3, M12, M24)** **D9.2** FEED Exploitation Plan (**M7**) **D9.3** Final report on the project dissemination and communication activities (**M36**)										
#	**10**	**Lead beneficiary**					**CNR**			
Management and coordination										
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Name	CNR	CREA	ITB	CSIC	AIJU	ARO	UNI ZG	Argonauta	ATÜ	BGT
PM	10	0.5	2	1	0.5	0.5	0.5	0.5	1	0.5
Start month: 1					**End month: 36**					

Objectives:

- To ensure efficient management and administration of the project
- To ensure efficient communication among the participants as well as with the PRIMA officer;
- To ensure that all the financial, contractual and ethical issues are correctly addressed; to provide assistance and advice to partners regarding administration and reporting; to identify potential problems at any stage and provide timely effective solutions;
- To ensure coordination among partners;
- To coordinate the Data Management Plan
- To set up the Innovation Board (IA) and to develop the Innovation Management strategy of FEED

Task 10.1 Operational and Financial Management

- Organisation of the kick-off and Final Meetings; Organisation of the WP meetings and production of minutes; acting as permanent contact point for the project and the Prima project officer;
- Timely delivery of the project's reports and deliverables;
- Coordinating the logistics of the produced samples during WPs
- Establish and maintain financial records;
- Coordinate financial statements submission by all Partners, follow up of PRIMA payments

Task 10.2 Internal information, communication and risk management

- Coordination of the internal communication strategy and resolution of the conflicts among Partners and the Consortium
- Coordinating the knowledge management activities within the Consortium
- Regular communication with the other WP Leaders will ensure early identification of potential problems to ensure that adverse situations will be managed properly throughout the project's evolution.

Task 10.3 Data Management Plan and Innovation Management strategy

- Generation and updating over the lifespan of the project of the Data Management Plan.
- Strategies for the future of FEED products and how the developed products could be tested by different end-users will be discussed with the stakeholders and a strategy report will be prepared. CNR will work with the IA, which will include the partners of AIJU, Italbiotec, Argonauta and those involved in foodstuff production.

Task 10.4 Promotion of gender equality

- Supervise the balance between women and men in the research teams who will implement the project; ensure of integrating sex and gender analysis in the cosumer acceptance and social awareness; consider gender balance for dissemination and training activities.

Description of Deliverables:

D10.1 kick-off meeting result report, financial agreements. The report includes the minutes of the meeting, the coordination of the work, and the review and planning of upcoming tasks (**M2**)
D10.2 Open Data Management Plan (**M6, 18, 36**)
D10.3 Report on risk management and mitigation, updated during project runtime (**M12, 24, 36**)
D10.4 Innovation management strategy outline for FEED (**M12**)
D10.5 Mid-term and final reports. Include all scientific and technical progress of the project including deviation from the plan, if any (**M18, 36**)
D10.6 Innovation management strategy report for FEED (**M36**)

Interaction between the WPs

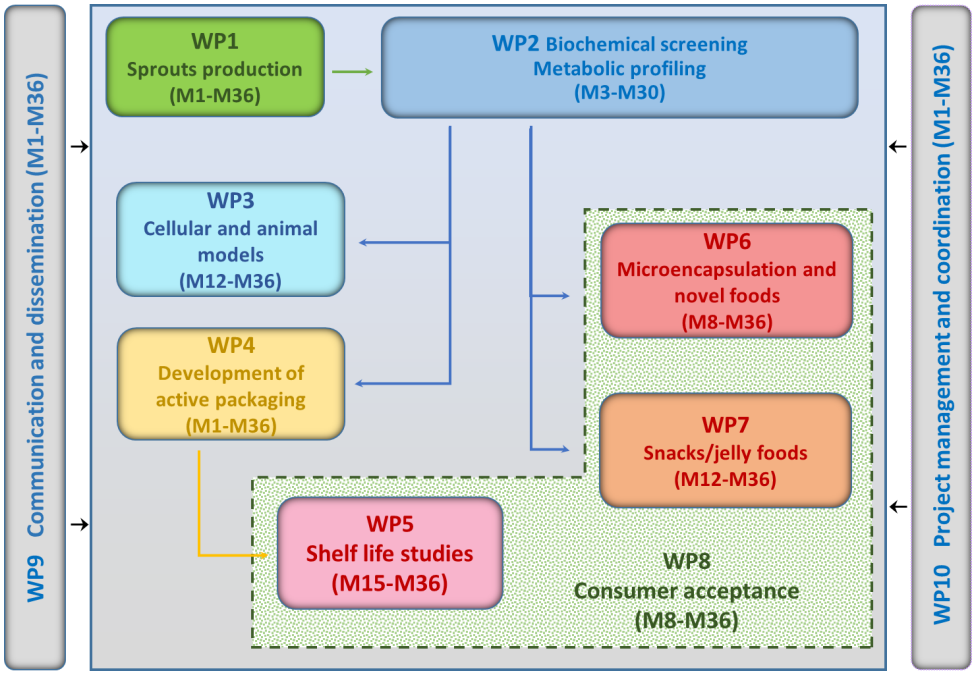

WP1
Sprouts production
(M1-M36)
WP2 Biochemical screening
Metabolic profiling
(M3-M30)
WP3
Cellular and animal models
(M12-M36)
WP4
Development of active packaging
(M1-M36)
WP6
Microencapsulation and novel foods
(M8-M36)
WP7
Snacks/jelly foods
(M12-M36)
WP5
Shelf life studies
(M15-M36)
WP8
Consumer acceptance
(M8-M36)
WP9 Communication and dissemination (M1-M36)
WP10 Project management and coordination (M1-M36)

Table 3.1c: List of deliverables

Deliverable #	Deliverable name	WP #	Lead	Type	Dissemination level	Date (month)
1.1	Report on the production of selected sprouts for chemical extracts	**1**	**CNR**	**R**	**CO**	**12**
1.2	Protocol on optimised sprout production under different lighting conditions	**1**	**ARO**	**R**	**CO**	**30**
1.3	Pilot- Scale sprouts production	**1**	**ARO**	**DEM**	**CO**	**36**
2.1	Report on the antioxidant potential and sensory evaluation of selected sprouts	**2**	**CNR**	**R**	**CO**	**18**
2.2	Report on the study of LC-MS and NMR profiles of the 10 selected sprouted species	**2**	**CREA**	**R**	**CO**	**36**
2.3	Detailed report on chemical composition, bioactives and antinutritional factors of the 10 selected sprouts species	**2**	**CREA**	**R**	**PU**	**36**
3.1	A overall health analysis (anti-oxidant and anti-inflammatory) report for the selected sprouts	**3**	**CNR**	**R**	**CO**	**34**
3.2	Report on the selected sprouts impact on in vitro microbiota and in vitro host response	**3**	**CSIC**	**R**	**CO**	**36**
3.3	Report on the specific sprouts effects microbiota and metabolomic profiles on the preclinical animal model	**3**	**CNR**	**R**	**CO**	**36**
4.1	Report on the development of biopolymer-based microcapsules suitable for edible coating and active metabolite formulation	**4**	**BGT**	**R**	**CO**	**13**
4.2	Manufacturing and characterization of active agent-loaded microcapsules	**4**	**BGT**	**R**	**CO**	**26**
4.3	Manufacturing and performance evaluation of biodegradable active coated thermoplastic films for sprout packaging	**4**	**CNR**	**R**	**CO**	**36**
5.1	Report on optimum modified atmosphere in preserving quality characteristics during sprouts shelf-life	**5**	**CREA**	**R**	**CO**	**30**
5.2	Report on optimum innovative packaging in preserving quality characteristics during sprouts shelf-life	**5**	**CREA**	**R**	**CO**	**36**
6.1	Obtaining of the microencapsulated sprout extract powder	**6**	**ATÜ**	**R**	**CO**	**30**
6.2	Report on the variation of quality properties of microencapsulated powder during storage	**6**	**ATÜ**	**R**	**CO**	**36**
6.3	Functional drinkable yoghourts “Ayran” and Turkish noodles “Erişte” production	**6**	**ATÜ**	**DEM**	**PU**	**36**
7.1	Realisation of 3DP functional snacks with added sprouts	**7**	**UNIZG**	**DEM**	**PU**	**25**
7.2	Realisation of functional jelly products with added sprouts	**7**	**UNIZG**	**DEM**	**PU**	**34**

Deliverable #	Deliverable name	WP #	Lead	Type	Dissemination level	Date (month)
7.3	Detailed report on the physicochemical composition, nutritional and sensory characterization of 3DP snacks and jelly products	**7**	**UNIZG**	**R**	**PU**	**36**
8.1	Report on consumer behaviour and user requirements	**8**	**AIJU**	**R**	**PU**	**24**
8.2	Report on consumer acceptance of prototypes	**8**	**AIJU**	**R**	**PU**	**36**
8.3	MED Board Game prototyp	**8**	**AIJU**	**DEC**	**PU**	**36**
8.4	Publishing e-manual for secondary school teachers	**8**	**Argonauta**	**DEC**	**PU**	**36**
8.5	Carbon footprint analysis report	**8**	**ITB**	**R**	**PU**	**36**
9.1	Dissemination and Communication Pla	**9**	**ITB**	**R**	**PU**	**3, 12, 24**
9.2	FEED Exploitation Plan	**9**	**ITB**	**R**	**CO**	**7**
9.3	Final report on the project dissemination and communication activities	**9**	**ITB**	**DEC**	**PU**	**36**
10.1	Kick-off meeting results report	**10**	**CNR**	**R**	**CO**	**2**
10.2	Data Management Plan, updated during Project runtime	**10**	**CNR**	**R**	**CO**	**6, 18, 36**
10.3	Report on risk management and mitigation, updated during project runtim	**10**	**CNR**	**R**	**CO**	**12, 24, 36**
10.4	Innovation management strategy outline for FEED	**10**	**CNR**	**R**	**CO**	**12**
10.5	Mid-term and Final Reports	**10**	**CNR**	**R**	**CO**	**18, 36**
10.6	Innovation management strategy report for FEED	**10**	**CNR**	**R**	**CO**	**36**

3.2 Management structure, milestones and procedures

3.2.1 Organisation structure and decision-making procedure

FEED project is structured in 10 WPs and its management will be based on the coordination of CNR, with the help of an Executive Committee (WP lead partners) and the Consortium General Assembly. An Exploitation and Innovation Task Force completes the management structure. The proposed management plan will ensure that the Consortium will reach its objectives and meet the deadline as described in the respective WPs, deliverables and milestones. List of Milestones is given in Table 3.2a. Below a detailed description of responsibilities is reported.

Coordinator (C): the Coordinator (CNR) will be the unique point of contact with PRIMA and will supervise all the project activities and collect the deliverable and milestone reports with the aid of an administrative assistant. In addition the Coordinator will be responsible for:

- legal, contractual, ethical, financial, and administrative management of the consortium;
- distribution of the samples within the partners, including the required authorizations;
- ensuring that the project consortium agreement is updated and managed when required;
- organising Project Executive Committee and Project Management meetings.

The Project Board (PB): chaired by the Project Coordinator and composed of one representative per partner (10 members in FEED). Each project board member will be authorised to deliberate and decide on all matters, which include planning, reporting of scientific results, re-focusing the research efforts if necessary, undertaking dissemination efforts, and dealing with major project management issues Major changes in the work plan will be approved with a simple majority of 50 % plus one, and any proposed changes will be reported to and agreed with the PRIMA office. The PB will meet on a yearly basis.

The Executive Committee (EC): chaired by the Project Coordinator and composed of WP lead participants (defined for each project work package). These participants will be responsible for the coordination of the various tasks within the WP. They will be responsible, along with the respective **Task Leaders**, for the proper and on time execution of the different tasks within the WP as well as of the corresponding deliverables, controlling the scientific progress of the partners, organising specific work package activities, and synthesising the WP progress reports. The WP lead participants will also control the achievement of the main milestones, suggest and oversee the technical procedures to be implemented and thus ensure the high standards of quality within the work package. This body will be convened remotely every 6 months, although it could be adjusted as required. The Committee will produce short reports on the work progress, with special attention to the progress in deliverables and achieving project milestones.

Exploitation and Innovation Task Force: led by ITB and including one contact person per partner, this Task Force will be maintained throughout the project duration and will be responsible for revising the Exploitation Strategy and monitoring of the innovation-related activities (knowledge, IPR, exploitation issues, the set-up of follow-up activities) of the project (Task 9.2). The Exploitation and Innovation Task Force will meet once a year after the Consortium General Assembly meetings and will be active during and three years after the project, thus ensuring a long-term continuity of the project results.

Decision making procedures: Any decision regarding adjustment/modification within the activities proposed will be managed at the corresponding board level (from the Task Leader to WP leader and upwards). If a conflict arises and cannot be solved at a given level, it will be raised to the next level: WP leaders, Consortium General Assembly and finally Project Coordinator. A correctly empowered governance and control for the overall project management will be guaranteed by:

The Consortium agreement (CA): CA, based upon the Horizon 2020 Model clauses for Consortium Agreements that the EC will provide, approved, and signed by all project members, will be drawn up and come into force before the Grant Agreement. The purpose of the CA will be to formalise the organisation of the work between project partners, the management of the project, the intellectual property rights to be applied, the rights and obligations of the partners, including, but not limited to, their liability and indemnification and to supplement but not conflict with the provisions of the contract with the PRIMA.

The Project Management Plan: provides a documented plan for the management and control of the supporting processes necessary to the successful implementation of the project. It will contain the Project Management Structure and the Governing Bodies, the Project Planning in terms of tasks, deliverables and budget established to achieve the Project's Objectives, the Internal Communication Strategy, the Decision-making and Quality Control procedures and the Methodology for Risk Analysis and any other information relevant to support the project management.

Internal Communication Strategy: an Internal Communication Strategy will be scheduled to keep all partners informed about the project status through the planned periodical meeting described in WP10 (Management and coordination). The set-up of a project electronic repository will be organised, that will be accessible to the consortium members, where all common project information will be stored and updated.

3.2.2 Appropriateness of the organisational structure and decision-making procedure to the scale and complexity of the project

FEED consortium consists of 10 partners mainly belonging to academic organisations and two SME as subcontractors. Within each partner there will be students and post-doc research personnel to be hired to work on the project. The governance of this big consortium must ensure the proper development of the activities and must be effective in listening to everyone's requests and sayings. For this reason a high-level PB being representative from each partner of the consortium is a must. This Board will meet once a year for general discussion.

However, to tackle the conflicts or problems quickly and to take actions as early as possible, if the number of reported problems are high or need to be solved shortly the project board will organise online meetings. This solution will avoid the risk of affecting the overall progress of the project.

The creation of the role of a Project Coordinator, who will chair the PB is vital for the successful implementation of such a project. The responsibility of this position is to coordinate between the consortium and the fund provider, PRIMA. Additionally, the Work Package leaders' roles are vital as they will work at the grassroots level and they are responsible for delivering the actual deliverables of the project. Since each WP also includes various tasks independent of each other (sometimes more than one partner), another management level Task Leaders has also been defined. Task Leaders will mainly be reporting to the WP leader.

3.2.3. Inclusion of innovation management in management structure and work plan

The management of knowledge and intellectual property created through the work carried out within the project timeframe will be the responsibility of the Coordinator's Team. Within the consortium agreement, the intended allocation of IPR will be defined which will be agreed by all participants in the project and will cover the IPR issues including ownership of knowledge, protection of that knowledge, and access rights. Results generated in the project will be assessed in terms of IPR and whether necessary protection of the result is required. FEED will end up developing reformulated Mediterranean products. A particular consideration must be made to the potential changing needs of the population group, so innovation management is an unavoidable part of the FEED, and thus will be addressed during the project. A big challenge consists in finding a way to modify FEED products in the future based on the changing consumers' need to maintain the sustainable nature of FEED products. To this purpose an Innovation Board will evaluate the tasks and deliverables and make judgments and predictions and research on the further needs of the FEED consumers.

Innovation Board will include the partners of AIJU, Italbiotec; Argonauta and those partners involved in foodstuff production. They will start to meet after 18 months and will present their report in all PB meetings. However, Each partner can propose new ideas and technology to develop more functionalized products. Upon completion of the project, before the final meeting an Innovation Management Strategy Report will also be prepared to structure the frames of the future of FEED products.

3.2.4 Risk management @ FEED: The coordinator is responsible for monitoring the development of the project and also the risks at the consortium, whereas each WP leader is responsible for monitoring the risk of her/his WP. The Coordinator will inform the PRIMA of the status of each risk, through the Periodical Management Reports. Any urgent issues will be promptly reported to the PRIMA, after deliberation from the WP leader. The implementation risks have been already identified together with their mitigation actions, as summarised in Table 3.2b below. The Project Coordinator is responsible

for drafting a Risk Management Plan (Task 10.2) that will be monitored and updated at each reporting period.

3.3 Consortium as a whole

3.3.1 Competences, experience and complementarity of the participating organisations: Involving 10 partners from 6 Countries (Italy, Spain, Israel, Croatia, Turkey, Germany) FEED project has a wide coverage of the entire Mediterranean area, and will allow the project to investigate different consumers behaviour and acceptance as well as small holder practice in different social, economic and religious contexts. The consortium is different in background, with a proven track record in funded projects and also in top-level academic research. Expertise within the consortium includes many aspects of food science in a multidisciplinary and integrated approach: agronomy and plant genetics (CNR and ARO), biochemistry (CNR, CREA, ARO), biology and cell physiology (CNR and CSIC), chemistry of materials (CNR and BGT), agro-industrial and food processing (CREA), food science and technology (ATU and UNIZG), communication (AIJU, ITB and Argonauta), financial planning and business model (ITB). FEED aims to promote the consumption of functional food based on fresh vegetable sprouts or formulated as food ingredients and transformed to different foodstuffs (yoghurt, noodles, cookies or snacks, jellys). To this purpose the expertise of CNR and ARO in selecting and growing the plant material will be fundamental and a close-cooperation will be implemented to share all the technology. The need for a deep biochemical characterization of the sprouts will be addressed by the expertise of CNR and CREA through their competence in the field of biochemical characterization of agro-food products, with particular focus on bioactive compounds. Once characterised, the biological effects will be estimated through the expertise of CNR and CSIC in both *in vitro* and *ex vivo* assay, and on the microbiota changes following sprout consumption. A close connection among the CNR, ARO, CREA, CSIC partners will be necessary to establish the relationship among the sprout ingredients of the diet, the bioactive compounds content and the health effects. The issue of preserving these fresh foods will be addressed by the expertise of CNR and BGT researchers with a strong background in chemistry in the field of bio-based and biodegradable active packaging for extending the sprout shelf-life. These two partners will also be in strict cooperation with CREA researchers expert in food processing and shelf-life studies for quality improvement. To meet the demand of novel functional foods, UNIZG and ATU will dedicate themselves to the preparation of novel functional food formulations and to the implementation of non-thermal technologies processing, through their strong expertise in microencapsulation techniques and in creating innovative and high quality functional food products through 3D printing. The sensory analyses (CREA, UNIZG and ATU) of the new products will close the loop. ITB, AIJU and Argonauta will promote the healthy and sustainable novel functional foods among Mediterranean consumers, by assessing their products acceptability and increasing their social awareness. These three institutions will cooperate by comparing the consumer opinions obtained in their own country and trying to match together. These collaborations will be ensured by the Coordinator, who has vast experience in coordination of, and participation in funded research projects, supported by an established organisational structure devoted to European project management and administration.

Timing Chart of FEED

WP	Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
WP1. Sprouts production from different plant species	Task 1.1																																				
	Task 1.2																																				
WP2. High throughput screening regarding bioactive compounds, antioxidant activity, and antinutritional compounds of different sprouts	Task 2.1																																				
	Task 2.2																																				
	Task 2.3																																				
WP3. Experimental Models: advanced *in vitro* and *in vivo* models to validate beneficial selected sprouts-host interaction	Task 3.1																																				
	Task 3.2																																				
	Task 3.3																																				
	Task 3.4																																				
WP4. Development of edible coatings and biodegradable active packaging	Task 4.1																																				
	Task 4.2																																				
	Task 4.3																																				
WP5. Quality characteristics and shelf-life of packed products	Task 5.1																																				
	Task 5.2																																				
WP6. Microencapsulation of bioactive compounds for food ingredients	Task 6.1																																				
	Task 6.2																																				
	Task 6.3																																				
	Task 6.4																																				
WP7. Production of snacks and jelly food containing the selected healthy sprouts	Task 7.1																																				
	Task 7.2																																				
	Task 7.3																																				
	Task 7.4																																				
WP8. Consumer acceptance, social awareness, and carbon footprint	Task 8.1																																				
	Task 8.2																																				
	Task 8.3																																				
WP9. Communication and dissemination	Task 9.1																																				
	Task 9.2																																				
WP10. Management and coordination	Task 10.1																																				
	Task 10.2																																				
	Task 10.3																																				
	Task 10.4																																				

Table 3.2a: List of Milestones

Milestone #	Milestone name	Related WP#	Due date (month)	Means of verification
1.1	Obtaining appropriate amounts of sprouts for chemical and sensorial analysis	**1**	**12**	Provision of sufficient raw material to partners
1.2	Acquired data on sprout production under different lighting conditions	**1**	**30**	Preliminary protocols for sprout production under different lighting conditions
1.3	Identification of the most suitable lighting conditions for sprouts production	**1**	**34**	Higher content of bioactives under particular lighting conditions
2.1	Identify the antioxidant potential and sensory characteristics of different sprouts species and establish a subset of 10 species with the highest bioactive content	**2**	**18**	Measurements and laboratory tests
2.2	Setting up the extraction and characterization of bioactives in the 10 selected sprouts species	**2**	**24**	Measurements and laboratory tests
3.1.	List of potential health benefits (anti-oxidant and anti-inflammatory) of the selected sprouts tested and selection of the sprouts to be used in following tests	**3**	**34**	Report on the ex vivo antioxidant and antiinflammatory effects of the selected sprouts
3.2	Identification and list of specific microbial biomarkers and host response in vitro	**3**	**36**	Report on the microbial markers and specific genes and cytokines
3.3	Identification and list of specific microbial biomarkers and metabolites on the preclinical animal model	**3**	**36**	Report on the specific microbiota and metabolomic profiles on the preclinical animal model
4.1	Selection of suitable biopolymers for edible coatings and microencapsulation completed	**4**	**13**	Report on the development of biopolymer formulations for edible coating and active microcapsule processing
4.2	Optimised microencapsulation processes for the development of active packaging	**4**	**26**	Report on the development of biopolymer formulations for edible coating and active microcapsule processing
4.3	Production of two types of active packaging for sprouts	**4**	**36**	Manufacturing and performance evaluation of biodegradable active coated thermoplastic films for sprout packaging
5.1	Identification of the most suitable modified atmosphere conditions for preserving quality of sprouts during shelf-life	**5**	**29**	Data on quality characteristics of packed sprouts in different modified atmosphere conditions
5.2	Identification of at least one type of innovative packaging for preserving quality of sprouts during shelf-life	**5**	**35**	Data on quality characteristics of packed sprouts with different innovative packaging

6.1	Identification of the most suitable wall material combination for microencapsulation of sprout extract	**6**	**24**	High microencapsulation efficiency and bioactivity
6.2	Identification of the optimum spray drying conditions and formulation for microencapsulation	**6**	**30**	Obtaining a microencapsulated powder with high powder quality, microencapsulation efficiency, and bioactivity after in vitro digestion (a desirability function value over 0.6).
6.3	Acquired data on the storage properties of microencapsulated powders.	**6**	**36**	Report on the variation of micro-encapsulated powders during storage.
6.4	Obtainment of increased bioactivity with acceptable sensorial properties of functional ayran and erişte.	**6**	**36**	Data on the bioactivity and sensorial properties of functional foods.
7.1.	Determination of the level/profiling of bioactive compounds in selected plant sources	**7**	**19**	Report on the nutritive value of selected plant sources
7.2.	Defined 3DP processing parameters and the quality properties of 3DP snacks based on sprouts	**7**	**25**	Report on 3DP processing parameters and the quality properties of 3DP snacks based on sprouts
7.3.	Optimised non-thermal treatment with respect to stability of bioactive compounds	**7**	**31**	Report on optimization of non-thermal treatment with respect to stability of bioactive compounds
8.1	Carbon Footprint inventory template	**8**	**20**	Provide to partners an excel template to collect inventory data
8.2	Published E-manual for secondary school teachers	**8**	**36**	hptt link to and pdf version of the e-manual
8.3	Collected data on the consumer behaviour, user requirements, and consumer acceptance of prototypes	**8**	**36**	Report on consumer behaviour and user requirements. Report on consumer acceptance of prototypes
8.4	Developed educational materials (games and e-manuals) to increase social awareness	**8**	**36**	MED Board Game prototype
9.1	Setting of FEED social media accounts	**9**	**2**	Project social media are online and the first post is published
9.2	Completion of Project website	**9**	**3**	The project website is online and freely accessible by the public
9.3	Videos showing the outputs of the Project	**9**	**18, 36**	Online accessibility
9.4	Completion of webinars	**1-9**	**18,36**	Attendance of participants and feedback reports
9.5	Completion of stakeholder meetings in the form of open discussion and living labs	**9**	**18,36**	Attendance of participants and feedback reports
9.6	Min 2 dissemination/activity per year	**1-9**	**24,36**	Feedback reports/statistics
9.7	Publishing at least 4 research papers	**1-9**	**36**	Acceptance of papers
10.1	Kick-off meeting	**10**	**1**	Minutes distributed to partners. Social Media posts, press releases.
10.2	Project Management Plan	**10**	**2**	The plan to be followed during the project to achieve its objectives

Table 3.2b: Critical Risks for Implementation

Risk #	Description of Risk	Level of likelihood	WP #	Proposed mitigation measures
1	Bacterial contamination of the sprouts during the production process of sprouts from different plant species	Low	1	Implementing various measures of seed cleaning and sterilisation of the entire process of producing sprouts from different plant species, and especially from wild species
2	High variability of the ex vivo test using blood samples from different subjects	Medium	3	Increase the number of blood samples
3	Selected biopolymer for edible coating were not able to encapsulate the active metabolite/low loading efficiency	Low	4	Implementation of alternative encapsulation technologies, and/or reassessment of selected encapsulating polymers
4	The active natural agents may lose their activities after encapsulation or may not be released from the active packaging	Medium	4	Readdressing of the encapsulation process in terms of choice of feedstocks and processing
5	Active agents may affect microcapsule surface adhesion	Medium	4	Surface treatment of films to improve interfacial adhesion, including mechanical or chemical etching, plasma treatment; screening of alternative packaging film coating processes, e.g. chill roll calendering, dip coating, spray coating
6	Shorter shelf-life of packed sprouts with innovative packaging	Medium	5	Testing of alternative packaging materials or changing modified atmosphere for packaging
7	Low emulsion stability	Low	6	Using different monomeric emulsifiers (different PGPR types or Span 80 for primary emulsion; different Tween types for double emulsion). Applying different homogenisation techniques (rotor stator, ultrasound or high pressure homogenisation).
8	Low microencapsulation efficiency	Medium	6	Using protein-polysaccharide conjugates as the wall materials.
9	Undesirable sensorial properties in functional foods	Low	6	Changing the microencapsulated powder concentration and using glutamic acid to mask the potential undesirable bitter flavour.
10	Obtained snacks and/or jelly products with low sensorial quality.	Low	7	Optimise the formulation and manufacturing process of jelly products..
11	Risk of being allowed to do the testing of E-manual in schools due to some kind of pandemic regulation by the state	Medium	8	Organising the activity in outdoor spaces or online.

12	Selection of non representative sample of population	Low	8	Apply multiple statistical controls, variable adjustment and stratified analyses by clusters.
13	Low degree of consumers acceptance of MED-based prototypes	Medium	8	Optimisation of the products after feedback in order to find the proper balance among nutritional, rheological and sensorial profiles.
14	Low acceptance among children and teenagers among children of the educational materials created (games and e-manuals)	Medium	8	The educational materials will be adapted to children and teenagers needs and interests, through the participation of parents and teachers gathering feedback to succeed in the process
15	New pandemic situation impede to carry out face to face interviews with consumers	Medium	8	Telematic technology will be used to carry out the interviews, testing the developed material using videos and images and/or sending the samples to the consumers.
16	Lack of interest in the project results	Low	9	DCP will define specific dissemination and communication KPIs to monitor the performance of WP9 activities; the DCP will be updated regularly realigning the communication and dissemination strategy if signs of underperformance are detected.
17	Lack of commitment from the targeted EU projects and calls	Low	9	Regular communication with contact persons from these projects; ask for the Project Officer mediation; look for potential complementary projects under other Horizon topics or other Programmes
18	Partners under-performing, lacking resources or capabilities, or leaving the consortium	Low	10	Careful motivation of partners and suitable roles for each. In the case of an outgoing partner, the consortium will examine if remaining partners can support the tasks. If not, a replacing partner will be recruited among strong network of partners, according to rules defined
19	Failure to meet project's deliverables and objectives within planned timeline and budget	Low	10	Most partners have experience with funded projects. Regular meetings to ensure on-time activities and quality of deliverables. Continuous time and budget monitoring
20	Technical/administrative/IPR disagreement and cooperation problems among partners	Low	10	Regular communication between all partners. Strong organisational structure to ensure a smooth workflow. IPR management will be defined in the Exploitation Plan.

3.4 Resources to be committed

Table 3.4a: Summary of Staff Effort

#	Partner	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10	Total person-months per Participant	%
1	CNR	12	16	24	30	4	0	0	0	7	10	103	29.5
2	CREA	0	5	0	0	15	0	0	0	0.5	0.5	21	6.0
3	ITB	0	0	0	0	0	0	0	7	18	2	27	7.7
4	CSIC	0	11	20	0	0	0	0	0	1	1	33	9.4
5	AIJU	0	0	0	0	0	0	0	27.5	0.5	0.5	28.5	8.1
6	ARO	13	10	0	0	0	0	0	0	0.5	0.5	24	6.9
7	UNIZG	0	0	0	0	0	0	37	0	0.5	0.5	38	10.9
8	Argonauta	0	0	0	0	0	0	0	9	0.5	0.5	10	2.9
9	ATÜ	0	0	0	2	0	28	0	0	1	1	32	9.2
10	BGT	0	0.5	0	31	0	0	0	0	1	0.5	33	9.4
TOTAL		25	42.5	44	63	19	28	37	43.5	30.5	17	349.5	
%		7.2	12.1	12.6	18.0	5.4	8.0	10.6	12.5	8.7	4.9		

Table 3.4b: Other direct cost items (travel, equipment, other goods and service, large research infrastructure)

CNR	**Cost (€)**	**Justification**
Travel	15000	Participation in consortium meetings/conferences/dissemination events
Equipment	8000	Soxhlet apparatus, benchtop centrifuge
Other goods and Service	101177	Cost of reactives, reagents and kits needed for cell culture models, microbiology and molecular biology (buffers, tips, specific pipettes, plastic material, DNA/RNA extraction, ELISA, specific cell culture media and supplements, etc..); open-access publication cost and also, microbiota assays and sequencing
Total	124177	
CREA	**Cost (€)**	**Justification**
Travel	5000	Participation in consortium meetings/conferences/dissemination events
Equipment	-	
Other goods and Service	24929	Cost of chemicals and disposables for lab analyses, open access fee, sub-contracting for NMR analyses
Total	29929	
CSIC	**Cost (€)**	**Justification**
Travel	4500	Participation in consortium meetings, conferences and other events
Equipment	1200	-20ºC freezer and refrigerator to store the samples, DNA/RNA and cell culture reagents
Other goods and Service	41000	Cost of reactives, reagents and kits needed for cell culture models, microbiology and molecular biology (buffers, tips, specific pipettes, plastic material, DNA/RNA extraction, ELISA, specific cell culture media and supplements, etc..); open-access publication cost and also, microbiota assays and sequencing
Total	46700	
AIJU	**Cost (€)**	**Justification**
Travel	9000	Participation in conferences, dissemination events and consortium meetings
Equipment		
Other goods and Service	25000	10.000€ Consumer database in 4 MED countries to carry out the interviews with consumers (WP8); 14.000€ Board Game graphic design and prototype printing and Living Lab material for increasing social awareness (WP8); 1.000€ Translations of the questionnaires for consumers ann social awareness material (WP8)
Total	34000	
ARO	**Cost (€)**	**Justification**
Travel	6000	Participation in conferences, dissemination events and consortium meetings
Equipment		-
Other goods and Service	9960	Raw materials, chemicals, consumables, etc.
Total	15960	
UNIZG	**Cost (€)**	**Justification**
Travel	5700	Participation in conferences, dissemination events and consortium meetings
Equipment	33000	CIELab colorimeter device with standard accessories and software
Other goods and Service	10725	Cost of raw materials, chemicals, consumables, open access fee, sub-contracting for HPLC/microbial analyses

Total	49425	
ATU	**Cost (€)**	**Justification**
Travel	4800	Participation in conferences, dissemination events and consortium meetings
Equipment	-	-
Other goods and Service	30400	Raw materials, chemicals, consumables, etc.
Total	35200	
BGT	**Cost (€)**	**Justification**
Travel	7500	Participation in conferences, dissemination events, and consortium meetings
Equipment	-	
Other goods and Service	22500	Raw materials, chemicals, consumables, open access fee, sub-contracting for SEM, etc.
Total	30000	

Section 4: Members of the consortium

4.1. Participants (applicants)

CNR (Italy)	
General description	The National Research Council (CNR) is the largest public research institution in Italy, comprising more than 8.500 employees. The scientific network is organised in 88 Research Institutes, spread across the country and belonging to 7 Departments. Two Institutes are involved in the FEED proposal: the Institute of Agricultural Biology and Biotechnology (IBBA) and the Institute of Polymers, Composites and Biomaterials (IPCB). IBBA has solid experience in the study of secondary metabolites, in the extraction of bioactive compounds from different plant matrices and in the development of experimental methods for their biochemical characterization. IBBA has solid experience also in studying the effect of diet in health and disease, in particular in determining the gut microbiota profiles in humans and animal models. IPCB research activities converge in three main subjects: Advanced Materials for energy, packaging; Health and Nanomedicine; Green Chemistry and Sustainability with focus on biodegradable and biobased polymers, recycling and eco-sustainable additives and materials. In detail, the units involved have competences in the processing of sustainable polymers and additives, understanding of the aspects which rule the nanostructuring of coatings, preparation of substrates and definition of deposition techniques to address the design and realisation of active packaging based on biobased coatings.
Role and profile of key people	**Dr. Carlotta De Filippo** (F), Senior Scientist at IBBA-Pisa, is the Coordinator of the FEED project. She is an expert of the influence of diet in shaping gut microbiota by analysing Gut microbial communities and relative metabolites in humans and in animal models. **Dr Monica Mattana** (F), Researcher at IBBA-Milano, is expert in secondary metabolism studies and biochemical characterization of extracts from several plant matrices. **Dr Laura Pucci** (F), Researcher at IBBA-Pisa, expert in the nutraceutical characterization of foods, through the analysis of antioxidant, anti-inflammatory, anti-aging and anti-cancer properties. **Dr Pierfrancesco Cerruti** (M), Senior Scientist at IPCB, expert in sustainable polymer formulation and processing. **Dr. Marino Lavorgna** (M), Research Director at IPCB, expert in composite materials and polymer-particle interfaces.
Key research facilities, infrastructure and equipment	**CNR-IBBA**: laboratories equipped with microscopes, electrophoresis devices, centrifuges, laminar flow hoods, UV-Vis Spectrophotometer, HPLC with different detectors (UV, DAD, Fluorimetric and electrochemical),instruments for qualitative-quantitative chromatographic analysis TLC e HPTLC (Linomat 5 automatic sample applicator, a densitometer with a TLC Scanner 4), Illumina MiSeq, Real Time PCR phytotrons, growth chambers, animal facility. **CNR-IPCB**: Laboratories equipped with extrusion compression lines, SEM, TEM, AFM microscopes, FT-IR, UV-Vis spectrometers, DSC, TGA thermal analyzers, permeabilimeters, WAXD and SAXS devices, plasma treatment reactor, dip, spray and layer-by-layer coating devices, mechanical analysis equipment

Relevant publications and(or products, services	1. Strati F, Cavalieri D, Albanese D, De Felice C, Donati C, Hayek J, Jousson O, Leoncini S, Renzi D, Calabrò A, **De Filippo C**. New evidences on the altered gut microbiota in autism spectrum disorders. Microbiome. 2017 Feb 22;5(1):24. 2. **De Filippo C**, Cavalieri D, Di Paola M, Ramazzotti M, Poullet JB, Massart S, Collini S, Pieraccini G, Lionetti P. Impact of diet in shaping gut microbiota revealed by a comparative study in children from Europe and rural Africa. Proceedings of the National Academy of Sciences USA (PNAS). 2010, 107(33):14691-6. **3.** Dougué Kentsop, R. A., ...and **Mattana, M.** (2022). *Linum lewisii* Adventitious and Hairy-Roots Cultures as Lignan Plant Factories. Antioxidants, 11(8), 1526. 4. Arouna, N., Gabriele, M., **Pucci, L**. The impact of germination on sorghum nutraceutical properties. Foods, 2020, 9(9), 1218 5. **Moeini, A**.,... **Cerruti, P.**, & Santagata, G. (2022). Edible Polymers and Secondary Bioactive Compounds for Food Packaging Applications: Antimicrobial, Mechanical, and Gas Barrier Properties. Polymers, 14(12), 2395.
Relevant previous projects or activities	- 2021-2022 ***MAMMAL***- Coordinator- #21256 Minimally-modified AMino Microbiota heALth. EIT-Food - 2018-2021 European project ERA-NET, ***MEATIC*** - Coordinator Faecal microbiome as determinant of the effect of diet on colorectal-cancer risk: comparison of meat based versus pesco-vegetarian diets. JPI HDHL-INTIMIC - 2020-2022 ***sPATIALS3*** - Coordinator, Improvement of agri-food productions and innovative technologies for a healthier, safer and sustainable nutrition, funded by the European Regional Development Fund under the POR FESR 2014-2020 of Lombardy Region. - 2018-2022 European project ERA-NET, Project title: ***KEPT*** Knowledge Platform on food, diet, intestinal microbiomes and human health. Founder Agency *JPI HDHL-INTIMIC* - 2019-2023 ***BIO-PLASTICS EUROPE*** - Developing and implementing sustainability based solutions for bio-based plastic production and use to preserve land and sea environmental quality in Europe, funded by EU-H2020.

CREA (Italy)	
General description	The Research Centre for Engineering and Agro-Food Processing (CREA-IT) carries out research activity in the field of agro-industrial and food processing, especially on fruit and vegetables, through studies on technological innovation and product quality, with a view to an integrated and sustainable supply chain. CREA deals with the metabolic and sensory characterization of both fresh and processed agro-food products along the supply chain, processing optimization through traditional and innovative technologies, shelf-life studies for quality improvement, development of new products and recovery of waste and by-products.
Role and profile of key people	**Dr. Valentina Picchi** (F) and **Dr. Giovanna Cortellino** (F) are permanent Researchers at CREA-IT. **Dr. Picchi** is an expert in the field of biochemical characterization of agro-food products along the supply-chain, particularly focusing on bioactive compounds and antioxidant potential of plant extracts. **Dr. Cortellino** is a Food Technologist, and she is an expert in food processing and shelf-life studies for quality improvement.
Key research facilities, infrastructure and equipment	Biochemical laboratories equipped with HPLC with different detectors (UV, DAD, RI, Fluorometric and electrochemical), LC-MS, GC, GC-MS, EPR Spectrometer, UV-Vis Spectrophotometer, laboratory equipped for physico-chemical measurements, Electronic nose, Modified atmosphere packaging machine, Refrigerated chambers, Sensory lab.
Relevant publications and(or	1.Buccheri M., **Picchi V**., et al. (2021). Dynamic changes of antioxidants and fermentative metabolites in apple peel in relation to storage, controlled atmosphere, and initial low oxygen stress. *Sci Hort*, 288, 110312;

products, services	2.**Picchi V.**, et al. (2020). Phytochemical characterization and in vitro antioxidant properties of four *Brassica* wild species from Italy. *Molecules*, 25(15), 3495; 3.Di Bella M.C., Niklas A., Toscano S., **Picchi V.**, et al. (2020). Morphometric Characteristics, Polyphenols and Ascorbic Acid Variation in *Brassica oleracea* L. Novel Foods: Sprouts, Microgreens and Baby-Leaves, Agronomy, 10, 782, 4.**Cortellino G.**, et al. (2018). Shelf life of fresh-cut lamb's lettuce (Valerianella locusta L.) monitored by electronic nose and relationship with chlorophyll, a fluorescence and mechanical-acoustic test. *Post Biol Technol*, 136: 178-186. 5. **Cortellino G.**, et al. (2017). Influence of maturity degree, modified atmosphere and anti-browning dipping on texture changes kinetics of fresh-cut apples. *Post Biol Technol*, 124: 137-146.
Relevant previous projects or activities	*"Stayfresh - Novel strategies meeting the needs of the fresh-cut vegetable sector"*, granted by AGER-Fondazione in rete per la ricerca agroalimentare (2011-2014); "*NA-NOTOX – Chitosan nanoparticles to deliver antioxidants in wheat, to avoid biotic and abiotic stress and to improve the quantity and quality of grains"*, granted by Italian Ministry of Agriculture (2016-2018).

ITB	
General description	Consorzio Italbiotec is the Italian leading non-profit organisation in the biotechnology ecosystem, bringing together 70 innovators operating in Life Science, Bioeconomy and Agrofood sectors. ITB works on creating a permanent and cutting-edge platform to boost innovation by supporting innovation management and developing R&D activities related to the biotech technology transfer, communication and training. The team comprises 20 specialists with different skills and backgrounds and manages over 100 regional, national and international projects within bio-based, agro-food, life science sectors. ITB's core expertise include: EU funding programs consulting, training, communication, and innovation management.
Role and profile of key people	**Sara Daniotti** (F), with a master's degree in Advanced Biotechnology, is a project manager at ITB. Sara is the reference point of the Bioeconomy area, mainly involved in the development of innovative projects and services in the bioeconomy, circular economy, agri-food, and blue growth sectors. Her expertise encompasses European, national, and regional R&D projects as well as innovation management services for which she is author of several publications. Sara has also participated in several communication and dissemination activities and in organising different public events in Italy and in other EU countries. In the context of her areas of expertise, she also collaborates on the activities of the Lombardy Green Chemistry Association and the Cluster Blue Italian Growth.
Key research facilities, infrastructure and equipment	Italbiotec has its headquarters in Milan (registered office), and is active at four other sites within research centres and university departments. The research activities are coordinated by the R&D PROJECT MANAGEMENT business unit based at the business accelerator managed by ITB itself located in the Milan-Bicocca university campus. ITB provides incubated start- ups with an integrated system of services.
Relevant publications and(or products, services	1. Gatto F., **Daniotti S**., Re I. Driving Green Investments by Measuring Innovation Impacts. Multi-Criteria Decision Analysis for Regional Bioeconomy Growth. Sustainability. 2021; 13(21):11709. 2. Gatto F, Re I. Circular Bioeconomy Business Models to Overcome the Valley of Death. A Systematic Statistical Analysis of Studies and Projects in Emerging Bio-Based Technologies and Trends Linked to the SME Instrument Support. Sustainability. 2021; 13(4):1899. 3. Borroni M, Pozzi CM, **Daniotti S**, Gatto F, Re I. Multi-Criteria Decision-Making Approach for Nutraceuticals Greener Applications: The Cynara cardunculus Case Study. Sustainability. 2021; 13(23):13483.

	4. Puglisi E., et al. Optimizing bioremediation of hydrocarbon polluted soil by life cycle assessment (LCA) approach. Env. Eng. and Manag. J. 2019; 18: 2155-2162
Relevant previous projects or activities	1.GEMMA- GEnotypes of Lombard Corn and Microbiome: new perspectives for the control of toxigenic fungi and adaptation to climate change (Lombardy Region funded project. 2019. 36 months. € 478.000). ITB role: communication and dissemination, socioeconomic analysis through IPAT model; 2.NUTRI2CYLCE- Transition towards a more carbon and nutrient efficient agriculture in Europe (H2020. 2018. 48 months. €7.047.003,75). ITB role: Life Cycle Assessment; 3.FOODINTEGRITY (European Union, FP7, 48 months, €12M); 4.BOBCAT - Biotechnologies for sustainable production of bio-based commodities and specialty products in a cardoon-based biorefinery (Cariplo Foundation. 24 months. €300K). ITB role: communication and dissemination, LCA, MCDA.

CSIC (Spain)	
General description	The CSIC (Spanish National Research Council) is Spain's largest public research institution, and ranks third among Europe's largest research organisations. The CSIC is attached to the Spanish Ministry of Science, Innovation and Universities through the State Secretariat for Research, Development and Innovation, and plays a key role in scientific and technological policy in Spain and worldwide. Development and Innovation, and plays a key role in scientific and technological policy in Spain and worldwide. CSIC has 4 main missions: 1) to foster multidisciplinary scientific and technological research; 2) Knowledge transfer to industry and society; 3) Education and training of scientific and technical staff; and also, 4) Promotion of Technology Based Companies. CSIC has 120 Institutes spread across the country and covering different areas of Science and Technology. Within them, the main food science institutes, IATA-CSIC, is involved in this proposal.
Role and profile of key people	**Maria Carmen Collado** (F) (PhD 2005) is a group leader at IATA-CSIC and Adjunct Professor (2007-now) at the University of Turku, Finland. Her research work is multidisciplinary and includes microbiology, food science and nutrition areas. Her interests are focused on probiotics, microbiota and health and nutrition. Her current work includes basic and applied research on molecular analysis and evaluation of health effects of beneficial bacteria and probiotics, the microbial-host interactions, microbiome and its role in human health and diseases and also, the influence of perinatal factors during early life. Her team (Julian Beltran and also, the postdocs) will support the work to be done in the proposal and responsable in WP3.
Key research facilities, infrastructure and equipment	● CSIC has a large on-line service catalogue that opens the facilities of the rest of CSIC research institutes, creating a big platform for analysis support within the organism. Experimental samples are easily posted among them and results electronically submitted. ● IATA-CSIC possesses a building of 13.930 m2, distributed between laboratories and services of administration, library and computer science. There are also 6 research service subunits: Genomics, Proteomics, Cell Culture Laboratory, Microscopy and Isotopes Laboratory.IATA-CSIC is located in the Scientific Park of the University of Valencia, surrounded by research institutes of complementary disciplines and the science colleges. As part of the scientific park, IATA has access to the university facilities as Central Service for Experimental Research (SCSIE) and Central Unit of Research in Medicine, University of Valencia (UCIM-UV) that allow the direct access to all services, resources and equipment managed by its highly specialised personnel, also skilled in the bioinformatic analysis of the data obtained. The genomics section of the SCSIE provides genomics services that range from sample preparation to the analysis and interpretation of the results. We have access to sequencing

	platforms (Illumina, PacBio), metabolomics and proteomics platforms at SCSI-UV and FISABIO.
Relevant publications and(or products, services	1. Wang M,... Zhou J, Calvo-Lerma J, Liu Y, **Collado MC**, Barba FJ.Effects of Marine Bioactive Compounds on Gut Ecology Based on In Vitro Digestion and Colonic Fermentation Models. Nutrients. 2022 Aug 12;14(16):3307 2. Selma-Royo M,... **Collado MC**, Perez-Martínez G.Intake of Natural, Unprocessed Tiger Nuts (Cyperus esculentus L.) Drink Significantly Favors Intestinal Beneficial Bacteria in a Short Period of Time.Nutrients. 2022 Apr 20;14(9):1709 3. Sobral MMC, Gonçalves T, Martins ZE, Bäuerl C, Cortés-Macías E, **Collado MC**, Ferreira IMPLVO.Mycotoxin Interactions along the Gastrointestinal Tract: In Vitro Semi-Dynamic Digestion and Static Colonic Fermentation of a Contaminated Meal. Toxins (Basel). 2022 Jan 1;14(1):28 4. Arias-Borrego A, Selma-Royo M, **Collado MC**, Abril N, García-Barrera T.Impact of "chemical cocktails" exposure in shaping mice gut microbiota and the role of selenium supplementation combining metallomics, metabolomics, and metataxonomics. J Hazard Mater. 2022 Sep 15; 438:129444 5. Rocchetti G, Alcántara C, Bäuerl C, García-Pérez JV, Lorenzo JM, Lucini L, **Collado MC**, Barba FJ.Bacterial growth and biological properties of Cymbopogon schoenanthus and Ziziphus lotus are modulated by extraction conditions. Food Res Int. 2020 Oct;136:109534
Relevant previous projects or activities	1.CIRCALGAE- CIRCular valorisation of industrial ALGAE waste streams into high-value products to foster future sustainable blue biorefineries in Europe. (HORIZON-CL6-2021-CIRCBIO-01-09, 48m. f 21 participants across 11 countries, >€10M). CSIC: Coordinator 2.INITIALISE- Inflammation in human early life: targeting impacts on life-course health (HORIZON-HLTH-2022-STAYHLTH-02-01,72m. €7.5M). CSIC: Participant 3. ECOBIOTIC-Physiological and Ecological impact of pre- and probiotic interventions in relation to food allergy in early-life (ERA-HDHL: Addressing adverse and beneficial effects of food ingredients and food processing on hypersensitivities to food (FOOD HYPERSENS 2021; 36 m, €1.8M): WP leader

AIJU (Spain)	
General description	**AIJU** is the European Technological Institute specialising in children's products. Our mission is to assist throughout all the processes involved in creating new products based on consumer insights and bringing them to the market. The department involved in the proposal is the **User & consumer research department** and their expertise is the analysis of end-user behaviour, pedagogic & therapeutic questions, design of didactic materials, sociological & market studies, product validation with end-users in different countries.
Role and profile of key people	The **researchers involved in the project** proposal are: (i) **Mr Pablo Busó** *(M)* is the IP and he is an expert in analysis of children´s market and user behaviour, (ii) Paco Varela (M), PhD, expert in leading European projects related to consumer behaviour, (iii) Mª Isabel Pardo PhD (F) is expert in non-formal education content development and consumer user behaviour analysis, (iv) Clara Blasco (F), expertise education content and (v) Ana Mata (F) expert in consumer behaviour/acceptance and the development of non-formal educational material. AIJU will perform activities related to Coordination WP8, assessment of the user requirements and consumer acceptance of the develop prototypes (Task 8.1) and Developing games/toys for raising awareness of the MD benefits (Task 8.2).

Key research facilities, infrastructure and equipment	TOYLAB. Lab for observing children in an ecological environment; - CHILDLAB: Spy room with one-way mirror and video recording and streaming system, emotions measurement equipment; Database in Spain of 9500 families in Spain (21000 children) and more than 400 collaborating schools, kindergarten; Conference room: for holding events of more than 300 attendees.
Relevant publications and(or products, services	(i) *CHANGERS. Children´s profiles new segmentation. Insights and preferences of chilcren 4 to 12 y.o*. M. Costa-Ferrer, P. Buso-Alos, C. Blasco-López, R. Abril-garcía, M. Morante-Boent. Publisher: AIJU. 2021. ISBN: 978-84-09-27662-2. (ii) *The exploration of size and toddler interaction with liquid laundry detergent capsules.* Richmond, A., Schwebel, D. C., Morgan, C. H., Liang, Z. W., Boutoille, A., Buso, P., & Stijntjes, G. (2020). PLoS one, 15(12), e0244481. (iii)*: Toys & games Usability Evaluation Tool. Manual, Questionnaire and Development Process*. M. Costa, O. Périmo, S. Ray-kaeser. Publisher: AIJU (2018). ISBN: 978-84-09-00631-1. (iv) *CEN/TR 16918:2015. Technical Report. Safety of toys – Children's mouthing behaviour in contact with toys*. AIJU. Publisher: CEN. Official document (December 2015) and (v) *CEN/TR 16918:2015. Technical Report. Safety of toys – Children's mouthing behaviour in contact with toys. AIJU*. Publisher: CEN. Official document (December 2015).
Relevant previous projects or activities	*FUNTOMP (PRIMA 2020, GA 2032)*. Consumer studies in Mediterranean Diet (MD) food products. Research studies performed in 5 Mediterranean Countries (MC). *DELICIOUS (PRIMA 2021, GA 2131)*. Consumer studies in MD food products in 5 MC. *GENB (Horizon Europe, GA 101060501)*. Children analysis behaviour related to bioeconomy and its understanding in different European countries. *SOFTMANBOT (H2020, GA 869855)*. Research in the use of robots in the traditional toy industry and AIJU will study the industrial end-user perception of the use of robots in the industry. *IBUS (H2020, GA 646167)*. Research of new business models for toy industry, materials implementation and characterization, safety, and consumer perception.

ARO (Israel)	
General description	The Agriculture Research Organization (ARO) is Located at the Volcani Center campus in Rishon-LeZion, near Tel-Aviv, and it is the largest agricultural research facility in Israel. ARO's six institutes are responsible for Plant Sciences, Animal Science, Plant Protection, Soil, Water and Environmental Sciences, Agricultural Engineering, and Postharvest and Food Sciences. While encompassing the full range of agricultural research activities, ARO focuses in particular on arid zone agriculture, enabling Israel - a country short of all the resources required for agriculture - to achieve among the highest levels of agricultural output in the world.
Role and profile of key people	**Dr. Yiftach Vaknin Keinan** (M) is a tenured senior researcher at the Institute of Plant Sciences, the Department of Natural Resources in the ARO. He specialises in the development of new crops and innovative agro-technological methodologies for the food, pharmaceutical and bioenergy industries. **Gan Perez** (M) is the founder and owner of "Alalim", which is a centre for herbal and medicinal plants specialising in production and sales of herbal powders and extracts. **Udi Gross** (M) owns and operates a facility called "Udi's Sprouts" which grows and manufactures a vast array of edible sprouts and organic mushrooms.
Key research facilities, infrastructure and equipment	Fully equipped and operational green houses, growth chambers and agricultural fields. A modern facility for growing, harvesting and storing edible sprouts. A modern facility for storing, drying and grinding herbs and spices into powder.

Relevant publications and(or products, services	1.**Vaknin, Y**. et al. (2007). The potential of milk thistle (*Silybum marianum* L.), an Israeli native, as a source of edible sprouts rich in antioxidants. *Int. J. Food Sci. Nutr.* 20: 1-8. 2. Zaidman, B. Ghanim, M and **Vaknin, Y**. (2010). Effect of seed weight on seed vigor and early seedling growth of *Jatropha curcas*, a biodiesel plant. *Seed Sci. Technol.* 38: 758-767 3. Degani, A.V. Dudai, N. Bechar, A. and **Vaknin, Y**. 2016. Shade effects on leaf production and essential oil content and composition of the novel herb Eucalyptus citriodora Hook. Journal of Essential Oil Bearing Plants. 19: 41-420. 4. **Vaknin, Y**. Mogilevsky, I. (2019). Adaptive variation in vegetative, reproductive and chemical traits of the Mediterranean *Silybum marianum* L., under desert-adjacent conditions. Israel Journal of Plant Sciences. *Israel J. Plant Sci.* 66: 112-126.
Relevant previous projects or activities	Development of *Silybum marianum* as a new edible sprout, for export. 2007-2010. Granted by the Chief Scientist of the Israeli Ministry of Agriculture.

UNIZG (Croatia)	
General description	Faculty of Food Technology and Biotechnology University of Zagreb (FFTB) is a public higher education institution and the central place of academic education of experts in the fields of food technology, biotechnology and nutrition in the Republic of Croatia. For many years, FFTB has been educating highly qualified experts, conducting scientific research and professional projects in cooperation with industry and has been a major driving force of Croatian economic development in the above mentioned fields.
Role and profile of key people	PhD **Danijela Bursać Kovačević** (F) is a researcher and associate professor with international recognition and influence in the field of food science and technology. She has many years of experience in continuous work on scientific research projects at national and EU level, where she has been involved in the implementation of (non-) thermal technologies for the isolation or processing of various food products of plant origin, as well as agro-industrial wastes from the food industry. Recently, her special focus has been on functional foods in terms of sustainable production with the application of additive technology and processing with innovative technologies and the use of various plant resources with the aim of creating innovative and high quality functional food products.
Key research facilities, infrastructure and equipment	Laboratory for physicochemical measurements, monitoring of bioactive compounds by UV-Vis spectrophotometer. Laboratory equipped with equipment for the application of non-thermal technologies for extraction and processing, as well as a 3D printer with food grade certification.
Relevant publications and(or products, services	Awarded by the Clarivate™ Award in the top 1% of citations for agricultural science in the Web of Science™ (https://recognition.webofscience.com/awards/highly-cited/2021). 1. Granato, D., Barba, F.J., **Bursać Kovačević, D**., Lorenzo, J.M., Cruz, A.G., Putnik, P. (2019) Functional Foods: Product Development, Technological Trends, Efficacy Testing, and Safety. *Annual Review of Food Science and Technology*. 11(3), 1-26. 2.Tomašević, I., Putnik, P., Valjak, F., Pavlić, B., Šojić, B., Bebek Markovinović, A., **Bursać Kovačević, D**. (2021) 3D printing as novel tool for fruit-based functional food production. *Current Opinion in Food Science*, 41, 138–145. 3.Putnik, P., Kresoja, Ž., Bosiljkov, T., Režek Jambrak, A., Barba, F.J., Lorenzo, J.M., Roohinejad, S., Granato, D., Žuntar, I., **Bursać Kovačević, D.** (2019) Comparing the

	effects of thermal and non-thermal technologies on pomegranate juice quality: A review, *Food Chemistry*, 279 (2019), 150–161. 4.Granato, D., Putnik, P., **Bursać Kovačević, D**., et al. (2018) Trends in chemometrics: food authentication, microbiology, and effects of processing. *Comprehensive Reviews in Food Science and Food Safety*, 17(2018), 663-677.
Relevant previous projects or activities	PI for national scientific project "Hurdle technology and 3D printing for sustainable fruit juice processing and preservation".

Argonauta (Croatia)	
General description	Argonauta is a non-governmental, non-partisan and non-profit organisation for nature, environment, and sustainable development, based in Murter, Croatia with members, volunteers and employees made up of teams of experts from different fields. Argonauta contributes to the protection of nature and the environment, the revitalization and valorization of cultural and historical heritage, and encourages the development of active citizenship in a way that informs, educates citizens, creates, brings and promotes innovative solutions in the community, and operates at local, national and international levels.
Role and profile of key people	**Ivona Jadrić** (F), development director at Argonauta, with 15 years of experience in the NGO sector will be coordinating the Argonautas tasks of the project. **Sanja Kovačev** (F) , executive director of Argonauta, through managing the project “Flavours form Amphore”, Sanja collected insights into the world of food commodities highlighting the aspects of sustainability, nutrition, health and law. **Suzana Suman** (F), promotion coordinator at Argonauta, coming from a background of teaching and digital marketing, has experience in promoting the Mediterranean diet: she developed and implemented non-formal education program "Let`s be fit" with the aim of acquiring healthy Med diet habits, as well as the importance of these foods in our culture.
Key research facilities, infrastructure and equipment	Argonauta is coordinating the programs in two premises: local Community centre JEDRO, and Educational centre for sustainable development, on the Island of Murter, which is a great asset to work with beneficiaries of the different topics. Also being active for almost 20 years, Argonauta established firm connections in all sectors which helps us to implement projects on a high level.
Relevant publications and(or products, services	Manual **"Blue Eco-Patrol - manual for the implementation of the extracurricular educational program for sustainable development"**. The manual describes non-formal methods of education (directed to children), studies the concept of sustainability and gives examples for acting according to the principles of sustainable development. The goal is to encourage children to think critically, so that children adopt new values, and form attitudes that guide them towards a sustainable lifestyle.
Relevant previous projects or activities	“Flavours from Amphore”: the project objectives aim to promote a sustainable use of the fishing and maritime heritage of Murter and the FLAG area by presenting it through the symbol of the amphora, as an ancient packaging for essential foods.

ATU (Turkey)	
General description	Adana Alparslan Türkeş Science and Technology University (ATÜ) is a public university that has committed itself to its internationalisation process and set out to establish international partnerships with its counterparts abroad. ATÜ, which has made significant progress in its short history in the field of research, is presented as one of the most successful research institutions in the field of "Food Processing" throughout Turkey in the Scientific and Technological Research Council of Turkey

	(TÜBİTAK) national evaluation documents ("Competency Analysis of Turkish Universities According to the Research Fields - 2021").
Role and profile of key people	The research group consists of Assoc.Prof. **Zafer Erbay** (M), Dr. **Levent Yurdaer Aydemir** (M), and Dr. **Onur Güven** (M). Our research group will contribute with our experience in microencapsulation, emulsion preparation, spray-drying, optimization, and product development. The PI of the group is Dr. Erbay (50 peer-reviewed papers, h-index 23 according to Web of Science). Dr. Erbay's main research interests are drying technology, dairy technology, emulsification and encapsulation applications, and optimization. Dr. Aydemir studies food chemistry, functional foods, the bioactivity of food ingredients, and plant proteins whereas Dr. Güven is experienced in material science and surface characterization.
Key research facilities, infrastructure and equipment	In our laboratory, there are some lab-scale food production equipment: spray dryer, freeze-dryer, ultrasound homogenizer, high-pressure homogenizer, rotor-stator homogenizer, and various measurement devices: GC/FID, GC-MS, spectrophotometer, laser diffraction particle sizer, microscope.
Relevant publications and(or products, services	1.Salum, P., Berktaş, S., Çam, M., **Erbay, Z.**, 2022. Enzyme-modified cheese powder production: Influence of spray drying conditions on the physical properties, free fatty acid content and volatile compounds, *International Dairy Journal*, 125, 105241. 2. Himmetagaoglu, A.B., **Erbay, Z.**, 2019. Effects of spray drying process conditions on the quality properties of microencapsulated cream powder, *International Dairy Journal*, 88, 60-70. 3. Himmetagaoglu, A.B., **Erbay, Z.**, Cam, M., 2018. Production of microencapsulated cream: impact of wall materials and their ratio, *International Dairy Journal,* 83, 20-27. 4. Salum, P., **Erbay, Z.**, Kelebek, H., Selli, S., 2017. Optimization of headspace solid-phase microextraction with different fibres for the analysis of the volatile compounds of white-brined cheese by using response surface methodology, *Food Analytical Methods,* 10(6), 1956-1964.
Relevant previous projects or activities	2021-24: "Production of microencapsulated casein hydrolysate as a bioactive food additive by double emulsion/spray drying technique", *TUBİTAK project no. 120O763*; Coordinator 2021-2024. "Microencapsulation of sugar beet leaf protein hydrolysates with improved bioactivity via double emulsion", *TUBİTAK 3501 Program, project no. 120R078;* Participant 2020-2021. "Determination of bioactivity changes of peptides formed during production and *in vitro* digestion of enzyme-modified cheese with ripened white cheese flavor", *TUBİTAK project no. 120O088*; Coordinator 2015-2018. "Microencapsulated Enzyme-Modified Cheese Powder Production with Ripened White Cheese Flavor", *TUBİTAK pr. no. 115O229*; Coordinator 2016-2017. "Production and optimization of microencapsulated cream powder", *TUBİTAK project no. 215O948*; Coordinator

BGT-TUM (Germany)	
General description	The Technical University of Munich (TUM or TU Munich) (German: Technische Universität München) is a public research university in Munich. The Chair of Brewing and Beverage Technology at the Technical University of Munich (BGT-TUM) has been successfully researching and teaching bioprocess engineering and process control for many years. The research contents include, among others, PAT technologies, bioprocess analysis and sensor technology, chemometrics, Food packaging, fluid dynamics, and control engineering.

Role and profile of key people	**Dr. Arash Moeini** (M) is a Postdoc researcher at The Technical University of Munich (TUM). His studies concentrate on active food bio-packaging. He expanded his experiences on biopolymer modification and processing, extracting active metabolites from the plants, formulating natural compounds for different applications (food packaging, herbicides, insecticides, and wound dressing), and physicochemical characterization.
Key research facilities, infrastructure, and equipment	The BGT laboratories are equipped with a wide range of facilities from ATR-FTIR, DSC, TGA, Master sizer, and Zeta sizer to HPLC with different detectors (UV, DAD, RI, and Fluorometric), LC-MS, GC, GC-MS, UV-Vis Spectrophotometer. Besides, at the Weihenstephan campus, morphological analysis instruments are available (Light microscope and SEM).
Relevant publications and(or products, services	1. **A. Moeini**, et al. Formulation of secondary compounds as additives of biopolymer-based food packaging: A review, Trends Food Sci. Technol. (2021). 2. S. Mayer, M. Tallawi, I. De Luca, A. Calarco, N. Reinhardt, L.A. Gray, K. Drechsler, **A. Moeini**, N. Germann. Antimicrobial and Physicochemical characterization of 2,3 Dialdehyde cellulose-based wound dressings systems, Carbohydr. Polym. (2021) 118506. 3. **A. Moeini**, et al. Thermoplastic starch and bioactive chitosan sub-microparticle biocomposites: Antifungal and chemico-physical properties of the films, Carbohydr. Polym. 230 (2020). 4. **A. Moeini**, et al.Wound healing and antimicrobial effect of active secondary metabolites in chitosan-based wound dressings: A review, Carbohydr. Polym. 233 (2020). 5. **A. Moeini**, et al. Effect of pH and TPP concentration on chemico-physical properties, release kinetics and antifungal activity of Chitosan-TPP-Ungeremine microbeads., Carbohydr. Polym. 195 (2018) 631–641.
Relevant previous projects or activities	Fungal and plant metabolites formulated into biopolymers, with anti-mold activity for food packaging, Horizon 2020, 2017-2020; Development of novel microcapsules as a control agent for house dust mites with natural ingredients, Zentrale Innovation Mittelstand (ZIM), PN: **ZF4025045AJ9**, 2020-2022; Development of a sustainable, biodegradable bioplastic for use in packaging system, Zentrale Innovation Mittelstand (ZIM), PN: **ZF 4025045AJ9,** 2021-2023; Development of a sustainable, biodegradable bioplastic as an ABS substitute and its technical production, handling and processing, Zentrale Innovation Mittelstand (ZIM), PN: **ZF4025039SB9**, 2019-2022.

4.2. Third parties involved in the project (including use of third party resources)

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be subcontracted)	YES	NO
	X	
Al Alim Medicinal Herb Center Ltd. and **Udi's Sprouts** will be subcontracted for large scale production of sprouts to produce powder (Task 1.3).		
Does the participant envisage that part of its work is performed by linked third parties[1]	YES	NO
	X	
Based on the ARO's previous experience in seed collection and production of edible sprouts from native Israeli wild plants, the ARO will subcontract **Al Alim Medicinal Herb Center Ltd.** and **Udi's Sprouts** for sprouts growing. **Al Alim Medicinal Herb Center Ltd.** is an Israeli-based company		

[1] A third party that is an affiliated entity or has a legal link to a participant implying a collaboration not limited to the action. (Article 14 of the PRIMA Model Grant Agreement).

specialising in collecting, growing and marketing a large variety of herbs, spices and medicinal plants. Their contribution will be in the collection and production of seeds from wild plants for our edible sprouts. **Udi's sprouts** is also an Israel-based company that collaborates with Al Alim on a regular basis. They specialise in growing and marketing a vast array of organic edible sprouts, baby leaves and mushrooms. The ARO, in collaboration with Al Alim and Udi's sprouts, will participate in WP1 - Task 1.2 for the identification, collection and production of a large quantity of white mustard and milk thistle and eventually other species to provide enough raw material to be extracted for the production of novel foods (snacks/noodles/yoghurt/jellys).		
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the PRIMA Model Grant Agreement)	YES	NO
		X
Does the participant envisage that part of the work is performed by International Partners[2] (Article 14a of the PRIMA Model Grant Agreement)?		
		X

Section 5: Ethics and Security

5.1 Ethics

FEED will take into consideration ethical issues within the project. Both individual country and EU regulations will be respected. The objective of FEED is to promote the consumption of functional food in terms of fresh sprouts or to use the extracts from sprouts to formulate ingredients for transformed functional foods (yoghurt, noodles, cookies or snacks). These enriched products will have improved nutritional qualities and positive effects on several chronic and degenerative diseases, such as cancer, cardiovascular diseases, obesity, diabetes, inflammatory diseases, and will be adapted to specific cultural, social and religious preferences of different target countries. To prove these effects FEED needs this kind of study includes studies with animal models. Indeed, high fat diet fed mice will be used to assess if the in vitro antioxidant and antiinflammatory activities of the new food products, impact positively on the gut microbiota. The results obtained on animal models will be essential to evaluate the effectiveness of these new products on health. Mouse has been chosen since it is conventionally used for this study. The study will be conducted on elderly animals which will be given a diet with different percentages of sprouts or extracts, and the mice will not be subjected to any invasive manipulation. Moreover, the project proposal According to Directive 2010/63/EU, will be evaluated by the local Animal Welfare Body (AWB) before submission for approval to the central competent authority, the Ministry of Health. We are confident that the project proposal will be authorised by AWB and the Ministry of Health since the study guarantees compliance with the safety, ethics and welfare of the animals. In FEED project consumer studies will be performed. Due to the necessity of collecting personal data during the test with consumers, special attention will be paid to this issue, applying the Regulation (EU) 2016/679 of the parliament in every moment and of the council related with the personal data protection.

5.2 Security[3]

We declare that the project:

- does NOT involve any activities or results raising security issues;
- does NOT involve 'EU-classified information' as background or results.

6. References

Reference of FEED can be seen by reading the following QR Code.

https://qrco.de/FEED_Bibliography

[2] 'International Partner' is any legal entity established in a non-associated third country which is not eligible for funding under Article 10 of the Rules for Participation Regulation No 1290/2013.

[3] See article 37 of the PRIMA Model Grant Agreement