Brussels, 13 November 2018

COST 082/18

**DECISION**

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Subject: **Memorandum of Understanding for the implementation of the COST Action “SOURDOugh biotechnology network towards novel, healthier and sustainable food and bIoproCesseS” (SOURDOmICS) CA18101**

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The COST Member Countries and/or the COST Cooperating State will find attached the Memorandum of Understanding for the COST Action SOURDOugh biotechnology network towards novel, healthier and sustainable food and bIoproCesseS approved by the Committee of Senior Officials through written procedure on 13 November 2018.

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**MEMORANDUM OF UNDERSTANDING**

For the implementation of a COST Action designated as

**COST Action CA18101**
**SOURDOUGH BIOTECHNOLOGY NETWORK TOWARDS NOVEL, HEALTHIER AND SUSTAINABLE FOOD AND BIOPROCESSES (SOURDOmICS)**

The COST Member Countries and/or the COST Cooperating State, accepting the present Memorandum of Understanding (MoU) wish to undertake joint activities of mutual interest and declare their common intention to participate in the COST Action (the Action), referred to above and described in the Technical Annex of this MoU.

The Action will be carried out in accordance with the set of COST Implementation Rules approved by the Committee of Senior Officials (CSO), or any new document amending or replacing them:

a. "Rules for Participation in and Implementation of COST Activities" (COST 132/14 REV2);
b. "COST Action Proposal Submission, Evaluation, Selection and Approval" (COST 133/14 REV);
c. "COST Action Management, Monitoring and Final Assessment" (COST 134/14 REV2);
d. "COST International Cooperation and Specific Organisations Participation" (COST 135/14 REV).

The main aim and objective of the Action is to The main aim and objective of the Action is to exploit sourdough technology along the entire value chain in a circular economy standpoint: from the sustainable production of raw materials (cereals), through the exploitation of fermentation processes, to the valorisation of by-products and food wastes therefrom.. This will be achieved through the specific objectives detailed in the Technical Annex.

The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 116 million in 2018.

The MoU will enter into force once at least seven (7) COST Member Countries and/or COST Cooperating State have accepted it, and the corresponding Management Committee Members have been appointed, as described in the CSO Decision COST 134/14 REV2.

The COST Action will start from the date of the first Management Committee meeting and shall be implemented for a period of four (4) years, unless an extension is approved by the CSO following the procedure described in the CSO Decision COST 134/14 REV2.

TECHNICAL ANNEX

## OVERVIEW


### Summary

Traditional sourdough bread resorts to spontaneous fermentations leading to natural selections of microorganisms, mainly yeasts and lactic acid bacteria. Such microorganisms are essentially beneficial to humans and, concomitantly, inhibits propagation of undesirable microbiota. Sourdough fermentation was probably one of the first microbial processes employed by Man for food production and preservation. Sourdough bread stills widely manufactured at farm level across Europe and worldwide and is highly appreciated by consumers for its distinct flavour, texture and healthy attributes. Through a bottom-up approach, this COST Action network brings together a multidisciplinary group of scientists and SMEs/LEs dedicated for many decades to study cereals and sourdough technologies. SOURDOMICS will exploit sourdough technology through entire value chain: from sustainable cereals' production, through fermentation processes' exploitation, to by-products' valorisation in circular economy. In (***1***)-upstream, it aims at (***1.1***)-exploitation autochthonous (pseudo)cereals with good baking, nutritional and healthy attributes, while (***1.2***)-promoting a sustainable agriculture and preserving genetic diversity. Simultaneously, aims at contributing to develop new business opportunities to local farmers through their engagement into food processing with shared small-scale breadmaking facilities, and the integration into industrial and trade chains. Such features are in agreement with European Agenda for Food and Environment. In (***2***)-downstream, the biotechnological sourdough fermentation exploitation comprises several objectives: (***2.1***)-Design starter cultures with a wide range of biotechnological applications; (***2.2***)-Production of healthy and tasty varieties of bread, thus catalysing changes in consumers' diets and market orientations; (***2.3***)-Production of high-added value metabolites resorting to sourdough microbiota; and (***2.4***)-Valorisation of by-products from cereal production and sourdough technologies.


| Areas of Expertise Relevant for the Action | Keywords |
|---|---|
| ● Other engineering and technologies: Food science and technology<br>● Industrial biotechnology: Food microbiology<br>● Industrial biotechnology: Bioprocessing technologies (industrial processes relying on biological agents to drive the process)<br>● Industrial biotechnology: Fermentation<br>● Other engineering and technologies: Sustainability in food science and technology | ● Food biotechnology, quality and preservation<br>● Secure food chain and wealth traditional products<br>● Microbiota, food fermentation and breadmaking technology<br>● Genomics, proteomics, transcriptomics and metabolomics<br>● New business models, sustainability and circular economy |

### Specific Objectives

To achieve the main objective described in this MoU, the following specific objectives shall be accomplished:

Research Coordination

● To select and produce autochthonous (non)conventional (conventional and nonconventional) (pseudo)cereal (cereal and pseudocereal) seeds from gene banks with better baking, nutritional and healthy attributes, while promoting a sustainable agriculture and preserving the genetic diversity and heritage of cereals in Europe and worldwide.

● To contribute to develop new business opportunities to the local farmers through their engagement into food processing chains with (shared) small-scale breadmaking plants, and through their integration into the whole industrial and trade value chains.

● Screening and characterizing microorganisms from cereals and spontaneous sourdoughs and design microbial starter cultures with application in a wide range of agri-food industries.

● Resort to sourdough microbiota and cereals to produce functional metabolites, cereal fractions/molecules

and enzymes of high added-value and to be employed in agri-food, nutraceutical (dietary supplements and food additives), cosmetic and pharmaceutical industries.
● Production of healthy and tasty varieties of sourdough bread and other baking goods (e.g. biscuits, crackers, pastry, pizza, pasta and ready-to-eat sourdough sandwiches).
● Valorisation of by-products from cereal cultivation, breadmaking and other sourdough-based technologies, as well as from food wastes resulting from retailers.

Capacity Building
● Creation of a channel of in-house and international communication, stimulating collaborations among researchers and between them and farmers, companies and consumers.
● Bring together researchers, technologists and entrepreneurs from different academic backgrounds and research fields but with same common denominator: Cereals and Sourdough Technology.
● Integration of previous and ongoing research projects into SOURDOMICS, thus providing S&T expertise in various fields of sourdough technology.
● Effective knowledge exchange and transfer, including mechanisms of sharing analytical methodologies, equipment, infrastructures, samples and research efforts based on projects already funded.
● Compare studies and establish integrated objectives between research groups.
● Creation of a network of trainings and courses dedicated to the scientific fields that embraces sourdough and breadmaking technologies – thus allowing exposure of investigators at distinct career levels to most recent state-of-the-art and to new trends and industrial/commercial applications.
● Creation of “The Community of Sourdough”, i.e. a meeting and coordination body of research groups and other stakeholders geographically spread.

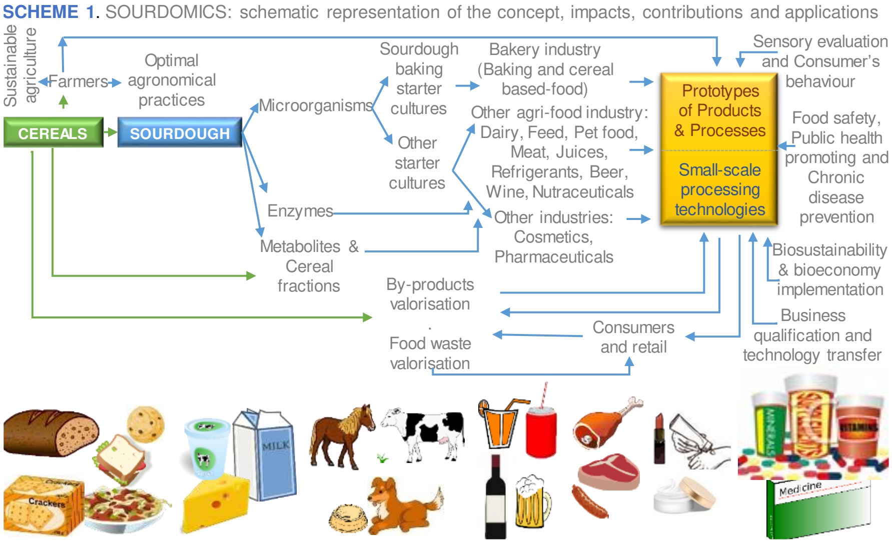
# TECHNICAL ANNEX

# 1.S&T EXCELLENCE

## 1.1. CHALLENGE

### 1.1.1. DESCRIPTION OF THE CHALLENGE (MAIN AIM)

**SCHEME 1.** SOURDOMICS: schematic representation of the concept, impacts, contributions and applications




**Main purpose** of COST Action **SOURDOMICS** – *Sourdough biotechnology network towards novel, healthier and sustainable food and bioprocesses* – is to exploit sourdough technology along entire value chain in a circular economy standpoint: from sustainable production of raw materials (cereals), through exploitation of fermentation processes, to valorisation of by-products and food wastes therefrom (**Sch. 1**). To achieve such a challenge, the SOURDOMICS COST Action network will bring together a multidisciplinary group of scientists who for many decades have focused their attention on technology of cereals, sourdough and breadmaking. Following a bottom-up approach, farmers, companies and other stakeholders will have a fundamental presence in the COST action consortium and its activities. Indeed, the great intent of this COST Action is to revisit and bring together Scientific and Technological (S&T) information from decades of research in sourdough science, since late 1970s, while going much beyond the acquired knowledge – in a way to respond to new Global Societal Challenges (SC), and to put these and novel (bio)advances at service of our society by providing and implementing effectively a varied and large number of novel industrial, agricultural and commercial applications (**Sch. 1**). This COST Action will be committed in gathering S&T knowledge spread by numerous research groups and companies worldwide, which led to the creation, from beginning, of an extensive and diverse consortium. It will be also committed in making researchers and enterprises to work together and to share knowledge, laboratorial facilities, research projects and other resources. Therefore, it is expected that such COST activities will: (***1***) Valorise currently dispersed S&T knowledge on sourdough technology via its comprehensive collection and integration, and further assessment of its potential to be concretized into prototypes with industrial and commercial interest; (***2***) Avoid duplication of research efforts, thus decreasing individual and overall research costs; (***3***) Accelerate S&T findings and conversion into practical applications; (***4***) Accelerate sourdough technology transfer and entrepreneurship; (***5***) Contribute to the cohesion of research groups from different countries, age groups, gender and career levels; (***6***) Contribute to strengthen the scientific capacity and research rankings of COST working members involved; and (***7***) To qualify and increase competitiveness of farmers and industries (**Sch. 1**).

### 1.1.2. RELEVANCE AND TIMELINESS

Nowadays sourdough bread and other sourdough-based baking goods (*e.g.* biscuits, crackers, pastry, pizza and pasta) are enjoying an increasing popularity as convenient, nutritious, stable, natural, low processed and healthy food. However, an increase of sourdough bread consumption will depend on innovation and improvement of cereal and breadmaking products and technologies to meet the required quality and modern consumers' demands and, thus, may influence consumers' preferences and market orientations. Moreover, baking companies are developing innovative products to compete in a globalizing market, and sourdough technologies may play an important role in such ambitions. In fact, the use of sourdough in bakery industry has received a great attention worldwide in recent years, as evidenced by the advent of a diversified (but limited) number of products in market and R&D activities dedicated by companies to this topic. As a matter of fact, SOURDOMICS aroused an enthusiastic interest in several companies – proven by their noteworthy presence. Some companies have even assumed our research topics as top priorities for their R&D and business strategies. Lastly, research around sourdough technology is decisively a hotspot in biotechnology not only in Europe but worldwide, which is noticeable by scientific activity and production (*e.g.* research manuscripts and projects) and the number of spread research groups focused on this field. Such a valuable scientific knowledge is dispersed and there is no kind of network so far that can be an aggregator and coordinator of knowledge and as a driving force for technological transference. SOURDOMICS emerged from this scenario and a worldwide representative network was built, in a scope which encompasses the entire bread cycle – from cereal cultivation to consumption and valorisation of by-products and food wastes (**Sch. 1**).

## 1.2. OBJECTIVES

### 1.2.1. RESEARCH COORDINATION OBJECTIVES

SOURDOMICS consists in 2 intervention platforms, namely Cereal production and Sourdough technology (**Sch. 1**). Specific aims were materialized and planned into Working Groups (WGs), which along with expected outputs and impacts are depicted in **Sch. 2**. In upstream (**CEREAL PLATFORM**), **specific objectives** are (**Sch. 2a**): (***1***) To select and produce autochthonous (non)conventional (pseudo)cereal seeds from gene banks with better baking, nutritional and healthy attributes, while (***2***) Promoting a sustainable agriculture and preserving genetic diversity and heritage of cereals in Europe

**SCHEME 2.** Specific aims of SOURDOMICS materialized into WGs and expected outputs and impacts: (a) Cereal and (b) Sourdough platforms

| **(a) CEREAL PLATFORM** | |
|---|---|
| **Working Group (WG)** | **Outputs and Impacts** |
| **WG1**. Recovery, characterization and selection of autochthonous conventional & nonconventional (pseudo)cereal seeds | - Cereals with better baking, functional, nutritional and healthy performance<br>- Sustainable (and non-extensive) conventional and organic agriculture and resilient seeds<br>- Optimization of agronomical practices towards: maximization production yields and nutritional value, reduction negative environmental impacts, prevent food losses, improvement circular economy<br>- Strengthen agriculture sector and its efficiency. Recovering diversity and preservation autochthonous regional cereal seeds. Exploitation of alternative cereals and pseudocereals and Improvement of post-harvest preservation and food quality<br>- Contribution to biological diversity, and save genetic resources and food heritage across Europe<br>- Open access web database on cereal seeds: repository of genotype, phenotype and technological data |
| **(b) SOURDOUGH PLATFORM** | |
| **Working Group (WG)** | **Outputs and Impacts** |
| **WG2**. Screening and characterization cereal flours and sourdough microbiota | - Inter-laboratory genotype and phenotype screening of yeasts, moulds (filamentous fungi) and bacteria (Gram-negative rods, endospore-forming and nonsporing Gram-positive rods, and catalase-positive and catalase-negative Gram-positive cocci)<br>- Contribution to microbiological diversity and save genetic microbial resources<br>- Overview of the potential applications of sourdough microbiota based on nutrition, health, functional and technological performance<br>- Open access web database on microbiota: genotype, phenotype and technological data |
| **WG3**. Design and development sourdough starter cultures for breadmaking & other agri-food products | - Optimized and controlled environmental and growth conditions for sourdough fermentations and other fermentation processes<br>- Design, formulation and preservation novel and stable (single and mixed) starter cultures (*a*) with better baking, functional, nutritional and healthy performances, and (*b*) for other agri-food sub-sectors and resorting to sourdough microbiota: Other cereal-based foods (ex. biscuits), Dairy, Feed and pet food, Meat, Juices, Refrigerants and other non-alcoholic beverages, Beer, wine and other beverages, Nutraceuticals (dietary supplements and food additives)<br>- Sourdough starter cultures specific for distinct sourdough fermentations and baking processes |
| **WG4**. Production, extraction and purification functional sourdough metabolites | - Production and optimization novel functional metabolites with biotechnological applications (biological activity or technological functionality) based on sourdough microbiota of bacteria, yeasts and moulds<br>- Bioengineered bacteria, yeasts and moulds towards improvement and optimization functional metabolite production yields<br>- Developed and optimized methodologies for extraction, separation and purification of functional (*a*) metabolites from sourdough fermentation, and (*b*) compounds/fractions from cereals with high-added value |
| **WG5**. Enzymatic processes based on cereals and sourdough technology | - Enzymes isolated and purified from cereals and sourdough, with interest for baking and other industries<br>- Physiochemical, biophysical and genetic characterization of novel enzymes<br>- Novel enzyme activities and metabolic pathways for industrial applications<br>- Open access web database on enzymology: structure, activity and application |
| **WG6**. Project design and development innovative prototypes of products and small-scale processing technologies | - New formulations and types of healthier bread and baking goods (ex. biscuits, cookies, pasta)<br>- Novel product and processing prototypes based on cereals, sourdough microorganisms, enzymes and metabolites, and applied to agri-food sub-sectors, *e.g.*: Dairy, Feed, Pet food, Meat, Juices, refrigerants and other non-alcoholic beverages, Beer, wine and other beverages<br>- Novel product and processing prototypes based on cereal compounds, and sourdough microorganisms, enzymes and metabolites and applied to cosmetic, nutraceutical and pharmaceutical industries.<br>- Optimization of preservation of nutritional, structural and functional properties of low processed food<br>- Development of local economy via local food value chains and valorisation of regional and locally produced/supplied food<br>- Innovative and flexible small-scale processing technologies tailored to farmers and SMEs/LEs. Shared food processing facilities and farmers engaging in food processing chains<br>- Reduction of food waste and efficient food processes |
| **WG7**. Valorisation of by-products, residues and food wastes throughout the entire value chain | - Valorisation of by-products, residues and food wastes from cereal cultivation, sourdough breadmaking processes and products' chain, cereal fractionations, fermentation processes and functional metabolite production. Valorisation by incorporation into new value chains: energy, agri-food and beverages, feed, nutraceuticals, pharmaceuticals and cosmetics.<br>- Developed and optimized methodologies for extraction or conversion, separation and purification of compounds from by-products<br>- Promotion of environment, social and economic sustainable development, reduction of food wastes, and competitive and circular economies |
| **WG8**. Food safety, health promoting, sensorial perception and consumers' behaviour | - Sustainable packaging for preservation local sourdough bread, ready-to-eat sourdough sandwiches and other goods, and other prototypes<br>- Promotion of health and prevent chronic diseases. Healthy, tasty and safety food diets. Linkage between food quality and public health<br>- Influence consumers' practices and market orientation. Trends in the market and consumers' preferences<br>- Consumers' practices to maintain healthy food attributes from purchasing to consumption |
| **WG9**. Economic feasibility, environmental sustainability, and business case development and team qualification | - Life Cycle Assessment (LCA), Product Environmental Footprint (PEF) and sustainable (non-extensive) agriculture, sustainable food products and processes. Promotion of environment, social and economic sustainable development<br>- Business cases' development and Economic Feasibility studies (EFS): Economic viability and environment sustainability of novel prototypes of sourdough-based products and processes<br>- Business qualification: Team and stakeholder qualification; Entrepreneur activities; Enterprises qualification; Promotion and sales<br>- New business models in local/regional food systems for farmers and companies, based on multi-actor approach. Job creation and retention in rural areas |

and worldwide. Simultaneously, it is expected that such efforts may contribute to develop new business opportunities to local farmers through their engagement into food processing chains with (shared) small-scale breadmaking plants designed within this COST Action, and through their integration in whole industrial and trade value chains. In downstream (**SOURDOUGH PLATFORM**), exploitation of sourdough fermentation technologies comprises several **specific objectives** (**Sch. 2b**): (***1***) Screening and characterizing microorganisms from cereals and spontaneous sourdoughs and design microbial starter cultures with application in a wide range of agri-food industries (**Sch. 1**); (***2***) Resort to sourdough microbiota and cereals to produce functional metabolites, cereal fractions/molecules and enzymes of high added-value and to be employed in agri-food, nutraceutical (dietary supplements and food additives), cosmetic and pharmaceutical industries; (***3***) Production of healthy and tasty varieties of sourdough bread and other baking goods; and (***4***) Valorisation of by-products from cereal cultivation, breadmaking and other sourdough-based technologies, as well as from food wastes resulting from retailers. These features of both platforms are in agreement with European Commission (EC) Agenda for Food and Environment, as reported in *European R&I for Food & Nutrition Security – Food 2030* [1].

### 1.2.2. CAPACITY-BUILDING OBJECTIVES

Although the impressive number of research groups working in (or related to) sourdough technology and breadmaking, researchers, companies, farmers, consumers and other stakeholders still live apart. The main reason for such behaviour lies in the effective lack of a network and efficient coordination. Self-governing intersection between various stakeholders happens predominantly at the end, *i.e.* with the advent of S&T publications. This information does not always reach all destinations either because of its intensive flow and dispersion or just due to the restrictive access to scientific publications, that makes it difficult to reach other circles but academy. Furthermore, such S&T information should be disseminated and communicated accordingly to the nature of target audience and, simultaneously, the access should be transversal to all stakeholders. In fact, platforms of communication and dedicated meetings on sourdough and breadmaking are very few and mismatched. Creation of an extensive COST Action network will allow to move the contact point to the start point, *i.e.* when objectives are defined, WGs are created and tasks assigned.

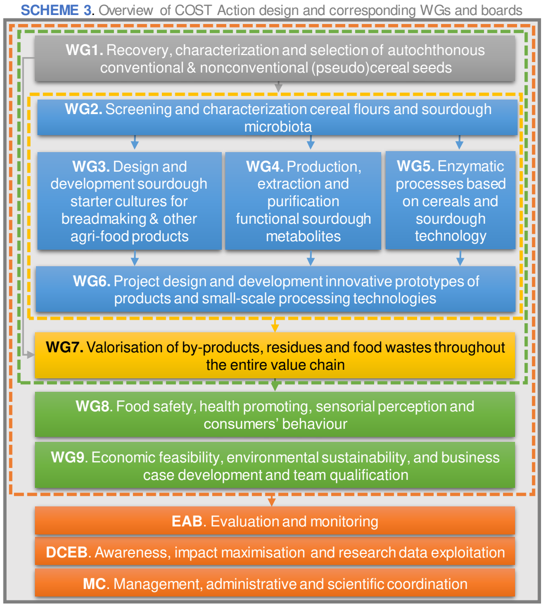
As a result, in terms of capacity to build objectives, this COST network will be a catalyst (***1***) To creation of a channel of in-house and international communication, stimulating collaborations among researchers and between them and farmers, companies and consumers; (***2***) To bring together researchers, technologists and entrepreneurs from different academic backgrounds and research fields but with same common denominator: Cereals and Sourdough Technology; (***3***) To integrate previous and ongoing research projects into SOURDOMICS, thus providing S&T expertise in various fields of sourdough technology; (***4***) To the effective knowledge exchange and transfer, including mechanisms of sharing analytical methodologies, equipment, infrastructures, samples and research efforts based on projects already funded; (***5***) To compare studies and to establish integrated objectives between research groups; (***6***) To create a network of trainings and courses dedicated to the scientific fields that embraces sourdough and breadmaking technologies – thus allowing exposure of investigators at distinct career levels to most recent state-of-the-art and to new trends and industrial/commercial applications; and (***7***) To create "**The Community of Sourdough**", *i.e.* a meeting and coordination body of research groups and other stakeholders geographically spread. Accordingly, this COST Action will attain transnational coordination objectives through following measurable indicators: (***1***) Attendance, presentation and organization of (on-site or online) S&T events, *e.g.* fairs, roadmaps, open days/weekends, congresses, seminars, workshops and webinars; (***2***) Joint patents and publications, *e.g.* open access S&T manuscripts in journals, books (/chapters), summary sheets, and divulgation in flyers, brochures, e-newsletters and multilingual websites, among others; (***3***) Collaborative research works and submission of (inter)national research and co-promotion project proposals resorting to SOURDOMICS network members; (***4***) Quali- and quantitative dimension of network, based on parameters such as: nº countries; gender and career level distributions; nº, type and field of SMEs/LEs, research centres and other representative institutions of stakeholders; new members and countries, and withdrawals; (***5***) Attendance and organization of face-to-face, on-line (e-learning) or b-learning advanced courses, training schools and Short-Term Scientific Missions (STSMs); and (***7***) Face-to-face and teleconferencing meetings of COST Action members (general meetings) and WGs (specialized meetings).

## 1.3. PROGRESS BEYOND THE STATE-OF-THE-ART AND INNOVATION POTENTIAL

### 1.3.1. DESCRIPTION OF THE STATE-OF-THE-ART

Bread plays a fundamental role in human well-being. Its nutritional value depends largely on its cereal composition, while its distinctive appeal arises from its aerated structure. Although white (wheat) bread with bakers' yeast has become widespread, it has not the taste, aroma, nutritional characteristics and long shelf-life of **traditional sourdough whole-grain bread**. Bread may prevent cardiovascular diseases, colon cancer, haemorrhoids, constipation, diabetes and arteriosclerosis, among others. **Starch** from cereals is the most appropriate energy source. **Cellulose** and other **insoluble fibres** have important regulatory functions in digestive tract, and are associated with low incidence of cancers [2,3]. In this context, **sourdough technology** is undergoing an increasing interest and SOURDOMICS is its materialization, by proposing biotechnological advances through foodomics (**Sch. 1-2**). Ground cereals mixed with water (and salt) produces a dough, which after some time and owing to spontaneous fermentation by a complex endogenous microbiota (mainly coming from cereals), become a sourdough, characterized by a typical acid flavour and increased volume. A piece of this spontaneously fermented dough – mother dough or sponge dough – can be kept aside and added to dough in next fermentation batch, thus serving as a natural ferment or microbial starter culture. This propagation process is the foremost original sourdough fermentation technology for bread manufacture. Sourdough provides several **technological advantages**, *e.g.* suitable swelling and baking quality, trigger enzymatic activity, improvement of flavour, loaf volume, texture and structure, and extent bread shelf-life, stability and protection from mould and bacterial spoilage, among many other benefits. Sourdough also holds a high potential to improve **nutritional value and health effects** of final food products. For instance, it reduces glycaemic response, increase minerals bioavailability, promotes formation of bioactive compounds (*e.g.* prebiotic oligosaccharides). Though the potential of cereals such as oat, sorghum and millet for gluten-free diets, their use in bakery industry still need considerable technological improvements and sourdough technology is a solution, due to, for instance, the lactic acid bacteria (LAB) proteolytic enzymes. In addition, cereals such as oat, rice, maize, sorghum, millet, teff and ragi, as well as pseudocereals such as buckwheat, amaranth and quinoa, are suitable for celiac patients and should be more explored. **Enzymes** can also be used to improve bread quality, and exploitation of new endogenous cereal and sourdough microbial enzymes for industrial application (*e.g.* amylases, proteases, phytases) is of high interest and is also planned in SOURDOMICS [4-11]. Furthermore, prolonged sourdough fermentation is more efficient than yeast fermentation in reducing **phytic acid** (an anti-nutritional factor). Some sourdough bacteria produce **exopolysaccharides** (EPS), which improve rheological, flavour and textural properties of bread, exhibit prebiotic properties, are potentially beneficial to gut health and have several applications in pharmaceutical and food industries. Sourdough fermentation is also crucial to **dietary fibre** degradation or solubilisation. Grain dietary fibre contribute positively to a long list of diseases (*e.g.* type-*2* diabetes, hypercholesterolemia, severe dental caries, constipation, obesity, colorectal cancer and coronary heart disease). It also reduces **starch** digestibility, thus lowering glycaemic and insulin index. Resistant starch (and other dietary fibres) has received much attention owing to its health potential benefits and functional (prebiotic) properties. Sourdough fermentation may influence positively gut health as a result of its role in modulating dietary fibre pattern, producing EPS with prebiotic properties and, probably, providing favourable bacterial metabolites to gut microflora [2-5,9]. Sourdough fermentation and baking play also an important role upon bread **flavour** and **aroma**, respectively. Compounds bearing a major effect upon bread flavour are organic acids, alcohols, aldehydes, esters and carbonyls, while aroma compounds upon bread flavour conveyed by bread are mainly a result of non-enzymatic browning during baking, fatty acid peroxidation and release microbial metabolites [12]. Sourdough fermentation results in production of microbial metabolites that contribute not only to food flavour, aroma, texture, digestibility and nutritional quality, but also to **food preservation and prevents food loss**. The production of organic acids (chiefly acetic and lactic acids), $H_2O_2$, $CO_2$, ethanol, diacetyl, bacteriocins and bacteriocin-like inhibitory substances (BLIS), among others, entails important **anti-bacterial and anti-fungal effects**. Sourdough fermentation preserves bread from spoiling, complying with consumers' demands for low-processed and natural (additive-free) foods [6,13-15]. However, knowledge on metabolic activity in these complex systems is still very incipient and needs further research, which would benefit from an increased cooperation of research groups through proposed the SOURDOMICS network. Finally, despite unique taste and aroma, spontaneous sourdough fermentation made by trial-and-error at artisanal and household scale is laborious and time-consuming, and deviations in bread quality between batches are frequent. Thus, development of **sourdough starter cultures** is of interest in industrial bakeries to avoid such variations and to attain several other advantages: reduction of costs, fermentation times and risk of spoilage; increase shelf-life; predict microbial metabolic activities and improve process control; improve sensory quality and food safety, *etc*. Production of industrial single/mixed starter cultures still needs much further investigations (as proposed in SOURDOMICS) to answer to technological demands of new baking industry, as well as to produce starters with novel properties (to baking and other agri-foods) and solve limitations such as metabolic activity and microbial stability, susceptibility to bacteriophage infections, spontaneous mutations or key-physiological properties' loss, optimal use is not straightforward and sensorial acceptance by consumers [6,7,10,14,15].

**SCHEME 3.** Overview of COST Action design and corresponding WGs and boards




### 1.3.2. PROGRESS BEYOND THE STATE-OF-THE-ART

Sourdough fermentation represents a (bio)technology with a broad diversity of applications yet to be explored. Although all attention given by scientific community, and more recently by an increasing number of companies, the acquired knowledge is dispersed and its straight use for benefit of society is very incipient. This COST Action proposal represents a decision made by several researchers from universities and companies to join efforts and explore effectively sourdough technology in several fronts (**Sch. 1-2**) towards scientific breakthrough and socioeconomic and environmental valorisation. An overview of COST Action design is depicted in **Sch. 3**. It is well recognized the sourdough potential to improve technological and nutritional value of baking products. Traditional processes for sourdough fermentation are laborious, time-consuming and little reproducible, making from single/mixed starter cultures an alternative for bakeries. Nevertheless, number of starter cultures commercially available are few and may present technological limitations and low consumers' acceptance. In addition, knowledge on microbial dynamics of sourdough starter cultures in such natural and complex matrixes (doughs) is embryonic. SOURDOMICS aims at developing new **starter cultures intended for baking and other agri-food industries** and getting a deeper knowledge on phenomena that takes place during sourdough fermentation, chiefly elucidation (rather than by screening) of specific metabolic pathways and interactions between microorganisms, and driving forces towards maintenance of a stable and productive consortium. It also aims at increase commercial diversity and availability of starter cultures, so that it is possible to get a greater diversity and quality of products in global market. In addition, by overcoming supply limitation of sourdough starter cultures in the market, it will contribute to increase and generalize consumption of sourdough baking products. SOURDOMICS will also develop **small-scale processing technologies** designed both to farmers and local bakeries, and to companies. It is expected that innovative and versatile systems may overcome major bottlenecks associated with logistic, technological and food safety constraints. In industrial bakeries, such processing plants will aid at attaining well monitoring and efficient processes. This novel concept will contribute to develop new business opportunities tailored for industry, local producers and farmers, and represents a promising tool to engage farmers into food processing circuit. Hence, SOURDOMICS combines technological innovation with socioeconomic and environmental impacts. Furthermore, sourdough bread is recognised as a natural, healthy, safety and tasty product. Novel and optimized **fermentation and baking processes** will be obtained to improve the quality of sourdough breads and others baking goods, and to understand the creation of their aerated structures. Once bread is generally consumed in a daily basis, increasing consumption of sourdough bread is a good vehicle to improve public health. It is also proposed in SOURDOMICS to bring to bakery industry new varieties of cereal seeds with better baking performance, and a greater **diversity of cereals** to improve nutritional value of bread. Sourdough fermentation and the use of nonconventional cereal and pseudocereal flours, wholemeal and bran for baking can improve quality of existing baking goods – *e.g*. gluten-free products or biofortified breads. Addition of structural and functional ingredients to food can improve significantly its quality and SOURDOMICS intends to identify and produce novel **functional compounds** resorting to sourdough microbiota and cereal fractions, and with potential application in several industrial sectors (**Sch. 1-2**). Additionally, **enzymes** are very popular in industry but deeper studies are required for new applications and better performances. In this COST Action novel enzymes from cereals, extreme acidic/temperature sourdoughs will be explored. Extraction, separation and purification methodologies will be developed and optimised, and novel **bioreactors** will be designed for such purposes. Furthermore, though food wastes may be a relevant bioresource, their exploitation in a circular economy approach is limited mainly due to economic and technical limitations. Actually, available extraction and recovery procedures are often more impacting to environment than the simplest existing solutions [16]. SOURDOMICS will assess new strategies and recovery technologies for **valorisation of by-products, residues and agri-food wastes** resulting from cereal cultivation and sourdough processes. Finally, choice of proper **packaging material** in agri-food industry is very important to provide good physical protection and increase shelf-life, and SOURDOMICS will evaluate and develop novel biodegradable and sustainable packaging and edible film solutions to agri-foods.

### 1.3.3. INNOVATION IN TACKLING THE CHALLENGE

**Sch. 1** shows the innovative approach in tacking challenge of SOURDOMICS and **Sch. 2** gives an overview of most important technological and socioeconomic advances and scientific breakthroughs. Large-scale population analysis of representative flour and sourdough microbiota will contribute to find interesting microorganisms to design new single/mixed starter cultures and produce functional metabolites of industrial interest, *e.g*. taste and flavour active compounds [amino acids (aa) and peptides, organic acids, alcohols, aldehydes, esters and carbonyls], bioactive phenolic compounds (phenolic acids, gallotannins, and procyanidins), antimicrobial and antioxidant metabolites (bacteriocins, BLIS, lactic and acetic acid, γ-aminobutyric acid, propionic acid, $H_2O_2$, benzoic acid, fatty acids, diacetyl), EPS (glucans, fructans and fructooligosaccharides). Cereals and cereal fractions will be employed as a source of functional and bioactive compounds, *e.g*. resistant starch, arabinoxylans, β-glucans, dietary fibres, ω-6/ω-3 fatty acids, phytosterols and phytostanols. Sourdough microbiota will be employed in fermentation of fibres, starch and gluten and development of symbiotic food. Design of bioengineered microorganisms will yield high productivities of metabolites. Similarly, it is likely to find enzymes of high industrial interest (not only for breadmaking) from a wide range of families, *viz*. glycoside hydrolases, laccases, oxidoreductases, lipoxygenases, lipases, phytases, proteases, α-amylases, hemicellulases, proteases, esterases, decarboxylases, reductases, transglutaminase. Development of novel processes and design of versatile processing units will contribute to create business opportunities and spin-offs in agri-food, nutraceutical, cosmetics and pharmaceutical industry. Development of sourdough technologies for breadmaking will trigger new business and organisational models between primary production and food processing. It will also result in production of minimal processed and natural breads (and other goods), with higher healthy and nutritional attributes and with unique textures, flavours and aromas. Cereals and other plant-based wastes will be valorised via production of dietary fibres and hemicelluloses, proteins, polysaccharides, lipids, phytochemicals and antioxidants. Hydrolysis of lignocellulosic or starch residues will yield fermentable sugars to be further fermented into biofuels, enzymes and bioplastics, among others. It can also be used to produce β-glucans and mannans. Residual biomass can feed further anaerobic digestions (to produce renewable energy and/or organic fertilizers) or pyrolysis processes. Lignocellulosic residues will also be used in solid state fermentations (STF) by filamentous fungi (moulds) and yeasts to yield single cell proteins. Bacteria fermentation of cellulose to produce 2,3-butanediol and bio-butanol will also be assessed. STF of by-products will yield several functional biomolecules: enzymes, antioxidants, vitamins, protein, aa, antimicrobials, *etc*, and fermented cake can directly use as an ingredient for pet food formulation. Fermented cake can be directly used as an ingredient for pet food formulation. SOURDOMICS will explore novel sustainable packaging and edible films suitable for baking (sourdough bread and baking goods, ready-to-eat sourdough sandwiches and other sourdough-based food) and other agri-foods using bio-based plastics, *e.g*. bio-PE, bio-PET, bio-polyurethane (bio-PUR), PLA, modified starch, cellulose derivatives and PHAs.

## 1.4. ADDED VALUE OF NETWORKING

### 1.4.1. IN RELATION TO THE CHALLENGE

It is essential the creation of a network – **The Community of Sourdough** – in order to effectively explore and transfer sourdough technology along entire value chain. Through networking it will be possible to gather and apply existing knowledge and to further define new research topics and applications – *i.e.* the overall challenge of SOURDOMICS. Involvement of companies, farmers and consumers will allow good targeting and direction of science and use of existing knowledge to implement new rural, industrial and commercial processes and products. By sharing knowledge, equipment, infrastructures and technology, COST members may acquire new skills in the broad range of S&T fields found in sourdough science. They will learn new methodologies and techniques, share and combine research data and optimize research efforts. In other words, networking will provide to farmers, companies and research centres with skilled human resources, and will provide to consumers with novel, healthier and sustainable food. Finally, multi- and interdisciplinary, and broad representation of countries in SOURDOMICS network will reduce traditional barriers to undertake studies involving different areas of knowledge. It will also act as an "activation energy" to overcome major handicaps encountered by young researchers in starting careers, and by well-established groups in exploring new and/or broader topics.

### 1.4.2. IN RELATION TO EXISTING EFFORTS AT EUROPEAN AND/OR INTERNATIONAL LEVEL

There are several (inter)national concluded and ongoing projects somehow or entirely related with sourdough technology – and with interest to this COST network. Yet, there is no COST action dedicated to this field of science and technology so far. This network, for a 4-y Memorandum of Understanding (MoU), involves several proposers and countries belonging to the 5 Continents. Consortium is made of researchers, farmers and SMEs/LEs (bakeries, cereal grain producers, milling, biotechnology, business incubator centres, project management and coordination consultancy, *etc*) with different backgrounds. Other stakeholders will be involved, namely cereal producers, rural household producers of traditional sourdough bread and consumers. Most proposers (from companies and research centres) are carrying out R&D works (to some extent or entirely) related to sourdough technology and to activities proposed in this COST work plan. Hence, activities developed and funded by this COST Action will be complementary to those research projects. SOURDOMICS also functions to consortium as a leverage instrument for potential funding of (inter)national research projects. This COST Action will also become a steppingstone for its members towards development of (inter)national project proposals – including to Horizon 2020 framework programmes. Actually, this COST Action establishes an extension of existing collaborations for some COST members, both in relation to research activities and submission of research projects. It will also promote brain-circulation and spread excellence through collaborative works, STSMs, training schools and conference grants. It is expected that, during SOURDOMICS time period, (inter)national grants can be obtained to support the activities of work plan. Furthermore, it is expected that existing research projects from members of SOURDOMICS network may support research activities of this COST Action. In turn, thanks to COST network these members with funded projects will have available new means for their research activities through a transnational coordination, *viz*. knowledge, methods, equipment, human resources, and a place of new ideas and initiatives. Even in absence of new financial support for research activities, SOURDOMICS plays key roles to aggregate current research information spread worldwide, to engage researchers into existing funded projects and to create new collaborations and opportunities for its members. Thus, this win-win relation can become a window of opportunities for both parts, *i.e*. to COST members with and without funded projects. In short, they will both benefit from mobility and networking tools of SOURDOMICS, thus contributing to COST Vision and Strategic Goals, *viz*. to promote and spread excellence, to foster interdisciplinary research for breakthrough science, and to empower and retain young researchers and innovators.

# 2. IMPACT

## 2.1. EXPECTED IMPACT

### 2.1.1. SHORT-TERM AND LONG-TERM SCIENTIFIC, TECHNOLOGICAL, AND/OR SOCIOECONOMIC IMPACTS

Most important S&T, socioeconomic and environmental impacts of SOURDOMICS are summarized in **Sch. 2**. Sourdough breads have enjoyed increasing consumers' popularity and this COST Action entails a major economic opportunity to cereal farmers, local bakeries, baking industries and food retailers. Sourdough technology provides technological advantages (texture, colour, flavour, shelf-life) to the manufacture of bread and baking goods and contributes to improve nutritional properties and health-promoting effects. Thus, SOURDOMICS is an opportunity to promote public health and the sustainable manufacture of traditional, local, natural and low processed baking products. Sourdough bread meets requirements of new consumers for low-processed, natural, healthy, safety, tasty and sustainable food. However, ancestral process of fermentation resorting to a mother-dough presents technical and economic bottlenecks only overcome with deeper knowledge and innovation. In SOURDOMICS, fermentation and baking processes will be developed and optimized using stable and safety sourdough starter cultures/mother-doughs. Flexible small-scale processing plants will be designed, intended to be used in different baking processes, in small batches and adapted to seasonal character of cereal production in small farms. Development of business models based on such concepts will expand sourdough market, both at farmer and industrial level. As a result, healthy food will be more available, with an impact in public health at medium and long-term. Development of novel sourdough breads and baking goods will not be restricted to novel starter cultures and breadmaking processes. CEREAL PLATFORM of SOURDOMICS will involve the screening, characterization and selection of varieties of cereal seeds for breadmaking, and optimization of agronomical practices towards a sustainable cereal cultivation. Simultaneously, alternative cereals and pseudocereals less used for baking will be studied and assayed in bread formulations, increasing diversity in market. Models for environmentally sustainable cultivation of cereals will be developed. Simultaneous development of SOURDOUGH and CEREAL PLATFORMS will bridge primary production and food processing, and result in new business opportunities in rural areas – thus in job retention. Indeed, proposed business models for sourdough bread are likely to stimulate at medium-term production of cereals and *vice-versa*. SOURDOMICS also proposes resorting to sourdough microbiota to develop starter cultures applied to other agri-food sub-sectors, as well as to produce functional compounds from sourdough microbiota and cereals, with potential application in agri-food, nutraceutical, cosmetic and pharmaceutical sectors (**Sch. 1**). Likewise, small-scale bioreactors will be designed. It is expected that SOURDOMICS will trigger structural changes in research, rural and industrial systems. By-products, residues and food wastes coming from such processes, food wastes and cereal cultivation will be subject to valorisation by incorporation into new value chains, thus increasing competitiveness, sustainability, circularity and diversity of regional and local food systems. Such approach is in agreement with *2030 Agenda for Sustainable Development* that underlines the need for promoting sustainability with rational use of edible resources [17]. Besides economic and environmental sustainability impacts, technological attributes given to sourdough bread and development of sustainable packaging and edible films will optimise preservation of naturally occurring nutritional, structural and functional food properties. In addition to socioeconomic and environmental benefits mentioned above, it is expected that both platforms contribute positively in many other ways: (***1***) To sustainability and circularity of cereal cultivation and breadmaking; (***2***) To save genetic resources and diversity of cereal seeds and food microbiota; (***3***) To preserve authenticity and heritage of traditional food; (***4***) To save cultural heritage related to manufacture of sourdough breads at farm level following ancient procedures and rituals; and (***5***) To help settling people in rural regions, thereby preventing rural exodus towards urban areas, including those small farmers seen by EU authorities as protective elements of environment. As a network, SOURDOMICS will also have several S&T and socioeconomic impacts. This first Action COST network exclusively dedicated to sourdough technology will connect experts spread worldwide, and foster and strengthen multi- and interdisciplinary collaborations between researchers, companies, farmers, consumers and consumer associations, policymakers, governmental authorities, regulatory authorities, standardisation bodies and laypersons. Such cooperation will enhance research activities and lead to science breakthrough, conversion of ideas into applications and consolidation of sourdough technology as a science. Research and financial efforts will be optimised. Laboratorial and human resources, analytical and technological methodologies will be pooled. State-of-the-art and existing research data will be revisited, compiled, used and updated. New joint research project proposals will arise. Individuals from scientific, agricultural and business community will be called to participate in this open and bottom-up network. COST dissemination and exploitation activities will play important roles in innovation and benchmarking of companies and increasing scientific productivity among researchers. It will have a major impact to inclusiveness by bridging science and innovation between different regions and generations.

## 2.2. MEASURES TO MAXIMISE IMPACT

### 2.2.1. PLAN FOR INVOLVING THE MOST RELEVANT STAKEHOLDERS

Concept behind SOURDOMICS is the exploitation of sourdough technology through sourdomics along whole value chain. Stakeholders involved and applications span agriculture, industry, retail and consumers. Biotech sectors of interest covers agri-food, nutraceuticals, cosmetics and pharmaceuticals. This COST Action was designed in a holistic approach, *i.e.* several fields of research are covered by its activities and consortium expertise: genomics, proteomics, transcriptomics, metabolomics, interactomics, foodomics. **Sch. 1-2** summarize overall concept underpinning SOURDOMICS and how influences various stakeholders. **Sch. 3** gives project design overview. CEREAL PLATFORM was designed to select (pseudo)cereals for baking industry. As a result of a close interaction between researchers and small farmers, agronomical practices for cereal cultivation will be evaluated and optimized towards improvement of food safety and quality, post-harvest preservation, and environmental and economic sustainability. Farmers will be supported to develop their own business and encouraged to innovate and improve quality. CEREAL PLATFORM will feed SOURDOUGH PLATFORM and will be simultaneously stimulated by results of the latter (**Sch. 1**). It is expected that such closed cycle can catalyse linkage between food processing and primary production, and the emergence of new business opportunities for farmers and SMEs/LEs. SOURDOUGH PLATFORM comprises actions in several directions (**Sch. 1**). In era of omics, it will involve sourdough-science community as a whole to screen and characterize cereal and sourdough microbiota. Large-scale data will be generated and will include results from research efforts made in last decades. Such microbial bank will help to track sourdough microbiota diversity, save genetic microbial resources and select potential interesting autochthonous microbiota for industry (**Sch. 1**). Since beginning, companies in consortium were encouraged to give a feedback of their needs, problems and challenges. Such Academy-Company interaction is of first importance to focus research in Societal Challenges and practical applications. Researchers in SOURDOMICS will also resort to cereal and sourdough microbial bank to identify and produce novel functional metabolites (biological activity or technological functionality) with industrial interest. Furthermore, they will resort to selected cereals to extract compounds/fractions with high-added value to industry, owing to its functional, technological and nutritional attributes. In addition, cereal and sourdough microbial enzymes with potential interest for baking and other industries will be screened and isolated, and a databank created. Above findings will allow the design and development of novel industrial prototypes of products/processes (**Sch. 1-2**), *e.g.*: Formulations and types of healthier bread and baking goods; Starter cultures, enzymes and metabolites for industry; Flexible small-scale processing units for farmers and biotech companies; Novel food processing methods, *e.g.* fermentation and baking; and Processes to better preserve nutritional, structural and functional properties of natural and low processed food. Consumers will be involved to understand their preferences and behaviour regarding new products. SOURDOMICS envisage to close cycle into a circular economy approach through valorisation of by-products, residues and food wastes, including valorisation of bread that is no longer marketable nor can be donated. Again, interdisciplinary of consortium and interaction with farmers, industrial companies and retailers will be of first importance; retailers will be particularly important to find efficient logistic systems in food chain and to provide food wastes. In another perspective, SOURDOMICS consortium is made of a large set of academic and company researchers and technologists with a long standing experience in cereal and food science and, particularly, in sourdough and baking technology. They benefit from a professional network in their specific fields, which will be brought into COST Action. Their scientific expertise spans microbiology and fermentation, (bio)chemistry, spectroscopy and chemometrics, mathematics, physics, molecular biology, health and life sciences, economy, engineering, packaging, flavour and sensory evaluation, environment, agriculture and veterinary, genetics and ecophysiology of cereals, among others. Such multidisciplinary is crucial for a successful implementation and execution of COST Action. A well balanced consortium was created regarding the presence of different countries and stakeholders.

Consortium includes following companies (SMEs and LEs): Biotechnology and food industry; Industrial bakeries; Cereal grain production; Retail (food and non-food) market that works closely with farmers and fresh food producers; Project design of specialised equipment and processing plants; and Consultancy company for dissemination, communication and exploitation (DCE), and for project management and coordination; and Incubation centre for business management and development, and technology transfer. Most companies have R&D activities, *e.g.* development of baking ingredients, new products or design of small-scale processing plants. Companies in consortium may have several roles, including participation in R&D activities of proof of concept (Technology Readiness Level, TRL3), validation in lab (TRL4), and validation (TRL5) or demonstration (TRL6) of prototypes in industrial environment. Farmers and companies are also potential end-users of prototypes developed during COST Action for production and commercialization. All scientific researchers and SME/LE partners have a long experience in participating in (inter)national research projects which, together with actual state-of-the-art, will serve as basilar stone for further and deeper investigations.

### 2.2.2. DISSEMINATION AND/OR EXPLOITATION PLAN

Dissemination, Communication and Exploitation (DCE) will be coordinated by a dedicated board (**DCEB**) elected from the (country representative) Action Management Committee (Action MC) – a committee nominated by Cost National Coordinators (CNCs). DCEB will be formed by 3 DCEB Coordinators (DCEBCs), a STSM Coordinator (STSMC), an Editorial Coordinator (EC) and a Webmaster, elected at first MC meeting, and a DCEB General Coordinator (DCEBGC) – which should be the DCE company of SOURDOMICS consortium. DCEB will be in charge of awareness, impact maximisation and research data exploitation (**Sch. 2**), through following tasks: (***1***). Dissemination plan set-up; (***2***) Stakeholder engagement towards continued outreach; and (***3***) Exploitation management. A close cooperation between COST members will be implemented to canalize all results from WGs, so that to reach efficient DCE – hence leading to long-term impact maximization. From start to finish of COST Action and beyond, DCE strategy will focus on user-oriented interactions, and a series of activities were planned to reach relevant target audience and general public. **Dissemination and Communication activities plan**. DCEB activities to share results with peers and other audiences includes: (***1***) Dissemination set-up with establishment of a strategy for DCE, *viz.*: objectives, target messages and relevant audience, operatives for promotion, valorisation of results and awareness-raising with their timing, responsible members and target, key performance indicators (KPIs), and editorial calendar setup; (***2***) Development of a dynamic, multilingual and user-friendly website. It will be the main interface amongst COST Action members and between them and target audiences. It will be an important dissemination and marketing channel for continued impact of COST Action outcomes. It will include a dynamic (WhatsApp, Skype and email) helpdesk and a content manager interface with COST information, such as public reports, publications, databases, e-libraries and professionally branded designed dissemination materials [*e.g.* flyers, brochures, factsheets, marketing/scientific posters and (e-)newsletters]. A private (password-protected) interface will facilitate communication and internal document management among COST members – who will be actively involved in multilingual web content generation and dissemination materials. An interface will allow a permanent contact, and perform and manage web conferencing meetings to complement the more expensive and time-consuming (but also more effective) face-to-face meetings. It will also allow organization of webinars, online advanced courses and STSMs; (***3***) Coordination of COST members towards best achievement of results: communication, knowledge and data share, and identification of needs and implementation of corrective measures; (***4***) Coordination, evaluation and dissemination of (inter)national events of S&T and public character; (***5***) Planning and organizing (inter)national dissemination and demonstration events: workshops, conferences, seminars, webinars, *etc*; (***6***) Participation in (inter)national meetings (*e.g.* co-located and co-organised, and MC, WG and core group meetings), roadmaps, fairs and other similar events to contact relevant stakeholders and disseminate results; (***7***) Establish direct interaction and cooperation with farmers, companies, researchers, policy arena, general public, among others, as well as with other relevant COST Actions and ongoing research projects; (***8***) Preparation of multilingual dissemination material with a professional design and a corporate identity of SOURDOMICS, to be used in public outreach activities; and (***9***) Planning and organising thematic groups, consumers' surveys, advanced training programmes, STSMs, *etc*. **Individually engagement**. On the other hand, all COST Action members will be individually engaged towards continued outreach – functioning as multipliers.

This will be fostered through: (***1***) Participation and dissemination on relevant events (conferences, fairs, roadmaps, exhibitions, *etc*), so as to present COST Action objectives, progress, and results tailored for industry, science and general public; (***2***) Participation and dissemination in local events and sites, *e.g.* science media centres, open days/weeks/weekends/summer holidays in universities, scientific festivals, thematic museums (*e.g.* bread cycle museums) and fairs, employment and entrepreneurship fairs; (***3***) Promotion through individual business and scientific networks and websites, participation in scientific societies and commercial magazines; (***4***) Development of local courses, training schools and laboratory courses, tailored to students and general public; (***5***) Publication of scientific manuscripts in open access peer reviewed journals, national journals and summary sheets of novel commercial solutions; and (***6***) Disclosure in social networks (Facebook, LinkedIn, Twitter, YouTube, *etc*) and traditional mass media (TV, radio, newspapers, magazines) to reach different audiences and facilitate awareness campaigns. **Exploitation activities plan**. DCEB activities referring to Intellectual Property (IP) Rights (IPRs) aims at protect members' interests and ensure appropriate attention to IP. It includes: (***1***) Implementation of a strategy to best raise awareness and protect key exploitable results (including IPRs) of COST Action. Particularly, general guidelines of IPRs and confidentiality will be subject to agreement between Action MC. DCEB will work according to grant and consortium agreements in order to identify results that should be protected through patents and copyright, and will advise COST members on most suitable means of protection. Complementarily, DCEB will review unpublished results and reports according to a set of reviewing criteria; and (***2***) Set-up of Exploitation plan aiming at stimulating and ensuring uptake of COST Action results. Such a plan will be continually improved during the 4-y MoU and presented to MC at least annually. Moreover, all COST members will be involved in: (***1***) Search and identify sources of financial support for COST research activities, such as grants and open calls for National/European projects; and (***2***) Business cases' and Economic Feasibility Studies (EFS), and environmental sustainability studies will be set-up and developed by COST members for novel prototypes resulting from SOURDOMICS' activities (**Sch. 1**). Furthermore, activities for team qualification (researchers, farmers, companies, consumers) and business qualification (entrepreneur activities, and promotion and sales) will be undertaken to better exploit outputs of COST Action.

## 2.3. POTENTIAL FOR INNOVATION *VERSUS* RISK LEVEL

### 2.3.1. POTENTIAL FOR SCIENTIFIC, TECHNOLOGICAL AND/OR SOCIOECONOMIC INNOVATION BREAKTHROUGHS

Potential for S&T and socioeconomic innovation breakthroughs of SOURDOMICS are described in **Sec. 1.3.3**, and complemented with **Sch. 1-2**. SOURDOMICS prototypes (**Sch. 2**) have a wide range of applications in global markets characterized by a high potential for growth and high return trade-off, *viz.* agri-food, functional (bioactive), nutraceutical, cosmetics and pharmaceutical (**Sch. 1**). A search intended for this proposal showed a small nº of patents, and mostly were related to specific processes of sourdough production – confirming the high potential of exploitation sourdough technology in all specific targets (**Sch. 1**), and also in agreement with its relevance and timeliness (**Sec. 1.1.2**). Moreover, holistic approach of SOURDOMICS to explore sourdough technology and its industrial/commercial applications is innovative and exhibits, by itself, a high technological and socioeconomic potential. As depicted in **Sch. 1**, concept of SOURDOMICS lies in exploitation of sourdough technology for production of numerous raw-materials/final products with high added-value, and for new business models. Innovation has an inherent risk and the high added-value is a decision-maker. Conversely, research activities fall in lab-to-market spectrum and will rely on product/process prototypes with a TRL ranging from 3 (experimental proof of concept) to 5 (technology validated in relevant environment). This means that there is a risk associated with the experimental nature of this COST Action, although unsuccessful experiments always represent a step forward in understanding the nature. However, and as described in **Sec. 1.4**, it is expected that COST Action network – and in particular its dimension (nº members), diversity and experience – may become a key tool to overcome major bottlenecks found to convert science into technology and research data dispersed worldwide into a ***HUB of knowledge in sourdough science and technology***. Finally, success of technology transfer will depend in several factors taken into account in this COST Action, *e.g.* DCE of results, public surveys and involvement of different stakeholders, and business cases' development and team qualification (**Sec. 2.2.1-2**).

# 3. IMPLEMENTATION

## 3.1. DESCRIPTION OF THE WORK PLAN

### 3.1.1. DESCRIPTION OF WORKING GROUPS

WGs and impacts are systematized in **Sch. 2**, whereas tasks, objectives, activities, milestones and major deliverables are delineated in **Sch. 4**. Nº of WGs was thought in a way to distribute coordination and leadership among various research groups and to establish good proportionality with COST network

**SCHEME 4.** Working groups (WGs), tasks (T), activities (A), milestones (M) and major deliverables (D): (a) Cereal and (b) Sourdough platforms. Outputs and impacts and Gantt diagram are depicted in **SCHEMES 2, 5**, respectively

| **(a) CEREAL PLATFORM** | |
|---|---|
| **WGs, Tasks (T), Objectives (O), and Activities (A) within time** [months] | **Milestones (M) and Deliverables (D) within** time [months] |
| **WG1. Recovery, characterization and selection of autochthonous conventional & nonconventional (pseudo)cereal seeds**<br>T1.1. Analysis of the state-of-the-art and case-study implementation [0-10]<br>T1.2. Selection, multiplication and characterization of autochthonous conventional and nonconventional cereal seeds from gene banks [0-36]<br>T1.3. Physicochemical, nutritional, rheological and technological characterization of cereal flours [6-36]<br>T1.4. Exploitation and optimization of (conventional and organic) sustainable cereal cultivation [6-42]<br>T1.5. Open access web database on cereal seeds [0-48]<br>OBJECTIVES: O1.1. Characterization and selection of (pseudo)cereal seeds for breadmaking; O1.2. Optimization of agronomical practices for sustainable cereal cultivation. ACTIVITIES (for more details please see Sections 1.2.2 and 2.2.2), A1: (*a*) Research and research coordination activities; (*b*) Attendance and organization of (on-site or online) scientific-technological events, *e.g.* fairs, roadmaps, open days, congresses and seminars, webinars and workshops; (*c*) Patents and scientific and technical publications, *e.g.* manuscripts, (chapters in/) books, summary sheets, and divulgation in flyers, brochures, e-newsletters and multilingual website; (*d*) Submission of project proposals; (*e*) Attendance and organization of on-site, online (e-learning) or b-learning advanced courses, training schools and STSMs; and (*f*) On-site and teleconferencing COST meetings. | MILESTONES:<br>M1.1. State-of-the-art on (pseudo)cereals for baking and case-study implementation [10]<br>M1.2. Characterization of cereal seeds and flours and web database repository [semi-annual]<br>M1.3. Scenarios of agronomical practices for cereal production maximization and environment impact minimization [annual]<br>DELIVERABLES:<br>D1.1. Progress report of (*a*) Dissemination, communication and exploitation and (*b*) Research activities and publications [semi-annual]<br>D1.2. Records of attendance in (on-site or online): Scientific-technological events, advanced courses, training schools; STSMs; and COST meetings [semi-annual]<br>D1.3. Organization of: 2 Scientific-technological events; 2 Advanced courses or training schools; and 2 STSMs [12-48]<br>D1.4. Open access web database on cereal seeds [46]<br>D1.5. Handbook "*Cereals and pseudocereals for baking and agronomical practices*" [44] |
| **(b) SOURDOUGH PLATFORM** | |
| **WGs, Tasks (T), Objectives (O), and Activities (A) within time** [months] | **Milestones (M) and Deliverables (D) within** time [months] |
| **WG2. Screening and characterization cereal flours and sourdough microbiota**<br>T2.1. Analysis of the state-of-the-art and case study implementation [0-10]<br>T2.2. Isolation, and genotype and phenotype characterization of microorganisms in cereals and sourdoughs: bacteria, yeasts and moulds (filamentous fungi) [0-24]<br>T2.3. Open access web database on cereal and sourdough microbiota [0-48]<br>OBJECTIVES: O2.1. Characterization and selection of microorganisms in cereals and sourdoughs. ACTIVITIES, A2: Please see A1 | MILESTONES:<br>M2.1. State-of-the-art on cereal and sourdough microbiota [10]<br>M2.2. Characterization of cereal and sourdough microbiota and web database repository [semi-annual]<br>DELIVERABLES:<br>D2.1 and D2.2. Please see D1.1 and D1.2, respectively [semi-annual]<br>D2.3. Organization of: 2 Scientific-technological events; 2 Advanced courses or training schools; and 2 STSMs [6-48]<br>D2.4. Open access web database on cereal and sourdough microbiota [46] |
| **WG3. Design and development sourdough starter cultures for breadmaking and other agri-food products**<br>T3.1. Selection of autochthonous sourdough bacteria, moulds and yeasts for starter cultures for breadmaking and other agri-food products [0-12]<br>T3.2. Dynamics and modelling sourdough fermentation processes [12-48]<br>T3.3. Formulation, control and preservation baking starter cultures [12-48]<br>OBJECTIVES: O3.1. Development of starter cultures and fermentation processes for breadmaking and other agri-food products. ACTIVITIES, A3: Please see A1 | MILESTONES:<br>M3.1. Selection of microbiota from individual banks and isolated within COST [12]<br>M3.2. Starter cultures and models for fermentation processes [semi-annual]<br>DELIVERABLES:<br>D3.1 and D3.2. Please see D1.1 and D1.2, respectively [semi-annual]<br>D3.3. Organization of: 3 Scientific-technological events; 2 Advanced courses or training schools; and 2 STSMs [6-48]<br>D3.4. Handbook "*Sourdough microbiota and starter cultures for industry*" [44] |
| **WG4. Production, extraction and purification functional sourdough metabolites**<br>T4.1. Identification novel microbial functional metabolites with biotechnological applications via metabolomics and large-scale functional genomics [0-24]<br>T4.2. Identification metabolic pathways involved in functional metabolite synthesis, and production optimization [12-48]<br>T4.3. Bioengineered bacteria, yeasts and moulds towards metabolite functional production optimization [18-48]<br>T4.4. Extraction, separation and purification of functional microbial metabolites and functional compounds/fractions from cereals [12-48]<br>OBJECTIVES: O4.1. Production of functional compounds from sourdough microorganisms and cereal fractions with industrial interest. ACTIVITIES, A4: Please see A1 | MILESTONES:<br>M4.1. State-of-the-art on functional metabolites and industrial applications [8]<br>M4.2. Identification of functional metabolites and metabolic pathways [semi-annual]<br>M4.3. Bioengineered bacteria and metabolite production [semi-annual]<br>M4.4. Extraction and purification of metabolites and cereal fractions [semi-annual]<br>DELIVERABLES:<br>D4.1 and D4.2. Please see D1.1 and D1.2, respectively [semi-annual]<br>D4.3. Organization of: 2 Scientific-technological events; 3 Advanced courses or training schools; and 2 STSMs [5-48]<br>D4.4. Handbook "*Production of cereal compounds and sourdough metabolites for industry*" [44] |
| **WG5. Enzymatic processes based on cereals and sourdough technology**<br>T5.1. Screening and isolation bacterial, mould and yeast enzymes [0-24]<br>T5.2. Enzyme extraction, purification and characterization [6-48]<br>T5.3. Global-scale gene mapping: elucidation of gene content and enzymatic repertoire [6-48]<br>T5.4. Open access web database on enzymology [0-48]<br>OBJECTIVES: O5.1. Production of novel enzymes with industrial interest. ACTIVITIES, A5: Please see A1 | MILESTONES:<br>M5.1. State-of-the-art on microbial enzymes and industrial applications [8]<br>M5.2. Identification, characterization and purification of microbial enzymes, and web database repository [semi-annual]<br>DELIVERABLES:<br>D5.1 and D5.2. Please see D1.1 and D1.2, respectively [semi-annual]<br>D5.3. Organization of: 2 Scientific-technological events; 2 Advanced courses or training schools; and 2 STSMs [6-48]<br>D5.4. Open access web database on enzymology [46]<br>D5.5. Handbook "*New microbial enzymes: from sourdough to industry*" [44] |
| **WG6. Project design and development innovative prototypes of products and small-scale processing technologies**<br>T6.1. Analysis of the state-of-the-art and case study implementation [0-8]<br>T6.2. Innovation in sourdough breadmaking technologies via fermentation and baking assays, to understand and control aerated structure and sensory properties [6-48]<br>T6.3. Innovation in other agri-food technologies, and cosmetic, nutraceutical and pharmaceutical technologies via fermentation [6-48]<br>T6.4. Design, development and characterization of novel and flexible small-scale baking facilities/plants and bioreactors for industry [24-48]<br>OBJECTIVES: O6.1. Project design and development of novel product and processing prototypes for baking and other agri-food, cosmetic, nutraceutical and pharmaceutical industries. O6.2. Design and development of novel and flexible small-scale baking facilities/plants and bioreactors for farmers and industry. ACTIVITIES, A6: Please see A1 | MILESTONES:<br>M6.1. State-of-the-art of fermentation processes [8]<br>M6.2. Novel product and processing prototypes [semi-annual]<br>M6.3. Novel processing plants for farmers and industry [semi-annual]<br>DELIVERABLES:<br>D6.1 and D6.2. Please see D1.1 and D1.2, respectively [semi-annual]<br>D6.3. Organization of: 2 Scientific-technological events; and 2 Advanced course or training school [6-48] |
| **WG7. Valorisation of by-products, residues and food wastes throughout the entire value chain**<br>T7.1. Analysis of the state-of-the-art and case study implementation [0-8]<br>T7.2. Extraction or conversion, separation and purification of compounds from by-products, residues and food wastes from: T7.1.1. Cereal cultivation and sourdough breadmaking processes; T7.1.2. Other fermentation processes, functional metabolite production and cereal fractionations [6-48]<br>T7.3. Valorisation of by-products by incorporation into new value chains (products and processes) [6-48]<br>OBJECTIVES: O7.1. Valorisation of compounds from by-products, residues, and food wastes resulting from SOURDOMICS' processes. ACTIVITIES, A7: Please see A1 | MILESTONES:<br>M7.1. State-of-the-art on methodologies for by-product conversion and valorisation [8]<br>M7.2. Extraction/conversion and valorisation of compounds from by-products, residues and food wastes. Production of functional biomolecules, *e.g.* enzymes, antioxidants, vitamins, protein, aa, antimicrobials, and further use of fermented cakes as ingredients, *e.g.* pet food formulation [semi-annual]<br>DELIVERABLES:<br>D7.1 and D7.2. Please see D1.1 and D1.2, respectively [semi-annual]<br>D7.3. Organization of: 2 Scientific-technological events; 2 Advanced courses or training schools; and 2 STSMs [12-48] |

**SCHEME 4 (cont.)**

| WGs, Tasks (T), Objectives (O), and Activities (A) within time [months] | Milestones (M) and Deliverables (D) within time [months] |
|---|---|
| **WG8. Food safety, health promoting, sensorial perception and consumers' behaviour**<br>T8.1. Analysis of the state-of-the-art and case-study implementation [0-8]<br>T8.2. Sustainable packaging and films for local sourdough bread and other goods [0-48]<br>T8.3. Effect of metabolites, sourdough and other agri-food prototypes on gut microbiome and mucosal immunity, and chronic diseases' biology and treatment [6-48]<br>T8.4. Role of sourdough microbiota and sourdough technologies on volatile composition and odour/aroma attributes of final food products and on global sensorial perception and preference of consumers [6-48]<br>T8.5. Public surveys on food, market, health and nutrition [12-48]<br>OBJECTIVES: O8.1. Development of sustainable packaging and edible films. O8.2. Assessment of nutritional and health-promoting attributes of sourdough prototypes. O8.3. Assessment of the effect of sourdough technologies on sensorial perception and consumers' acceptance. O8.4. Public surveys on food, market, health and nutrition.<br>ACTIVITIES, A8: Please see A1 | MILESTONES:<br>M8.1. State-of-the-art on food safety, health promoting and consumers' behaviour [8]<br>M8.2. Sustainable food packaging [semi-annual]<br>M8.3. Health promoting effects of SOURDOMICS´prototypes [semi-annual]<br>M8.4. Sensorial perception and preference of consumers and new market trends [semi-annual]<br>DELIVERABLES:<br>D8.1 and D8.2. Please see D1.1 and D1.2, respectively [semi-annual]<br>D8.3. Organization of: 2 Scientific-technological events; 2 Advanced courses or training schools; and 2 STSMs [9-48]<br>D8.4. Handbook "*Food safety, health promoting and consumers' behaviour around sourdough*" [46] |
| **WG9. Economic feasibility, environmental sustainability and business case development, and team qualification**<br>T9.1 Qualitative scoping: development of scenarios for cereal-based value chains [0-24]<br>T9.2. Economic Feasibility Studies (EFS) [12-48]<br>T9.3. LCA and PEF and recommendations for integral optimization of economic and environmental performance [12-48]<br>T9.4. Business cases' development and team qualification [12-48]<br>OBJECTIVES: O9.1. Assessment of the economic feasibility and biosustainability of different scenarios for cereal-based value chains. O.9.2. Development of business models and business plans. O9.3. Business qualification of team members and stakeholders.<br>ACTIVITIES, A9: Please see A1 | MILESTONES:<br>M9.1. Scenarios for future cereal-based value chains [8]<br>M9.2. EF, LCA and PEF studies [semi-annual]<br>M9.3. Business cases' development and team qualification [semi-annual]<br>DELIVERABLES:<br>D9.1 and D9.2. Please see D1.1 and D1.2, respectively [semi-annual]<br>D9.3. Organization of: 3 Technological events; and 3 Advanced courses [12-48]<br>D9.4. Economic Feasibility (EFS), Life Cycle Assessment (LCA) and Product Environmental Footprint (PEF) studies and Business plans [annual] |

size, so as a full commitment is ensured and length of each WG is reduced. CEREAL PLATAFORM (**WG1**) (**Sch. 4**) aims at selection and characterization autochthonous cereal (bread and durum wheat, kamut, barley, rye, oat, spelt, millet, rice and maize) and pseudocereal (quinoa, buckwheat and amaranth) seeds from gene banks with technological/nutritional interest for baking. Seed and flour characterization encompasses morphological, physicochemical, rheological, phytochemical, genetic, nutritional and baking properties. Agronomical and post-harvest practices for conventional/organic cereal cultivation will be assessed and optimized in collaboration with small farmers – so as high nutritional standards and low environmental footprints are attained. LCA, PEF schemes, business cases and EFS will be developed. Baking performance and health attributes of flours will be assessed. SOURDOUGH PLATFORM will be fed by previous outcomes. In **WG2**, a comprehensive genotype characterization, by metagenomics, and phenotype characterization, by cultural methods, of microbiota present in cereals and sourdoughs will be undertaken. Encrypted genetic potential and environmental expression of genetic traits will be revealed and microorganisms will be selected according to health, nutritional and technological attributes and target applications. Based on **WG2** outputs, sourdough starter cultures (**WG3**) will be designed for specific industrial applications (**Sch. 1**). COST members from companies will work closely with academy during prospection of biotech applications. Dynamics of single/co-culture fermentations will be evaluated and modelling, and environmental and growth conditions optimized to improve technological, nutritional and health attributes of sourdough. Driving forces and mechanisms that keep microbial consortia stable and productive will be elucidated by interactomics. Microorganisms from **WG2** will also be used (**WG4**) to identify novel microbial functional metabolites (biological activity or technological functionality) through metabolomics. Relevant microorganisms will be selected according to industrial interests. Afterwards, metabolic pathways involved in conversion of different substrates into high-added value functional metabolites will be elucidated, based on genome sequencing, functional genomics and biochemical approaches in selected microorganisms – thus, supporting strategies for production optimization. Cellular and molecular stress responses to different environmental conditions, and cell-death mechanisms will be investigated in microorganisms of interest. In addition, mechanisms of cellular transport and transporter proteins for production of high-added value metabolites will be studied, as well genes associated with regulation of fermentative processes. Based on above information, bioengineered microorganisms will also be constructed towards metabolite functional production. Appropriate methodologies for separation and purification of such metabolites will be developed and optimised. Furthermore, selected (pseudo)cereals (**WG1**) will be used to extract, separate and purify functional compounds/fractions therefrom, by means of chromatographic and other separation methods. Modern metagenomics technology will be used to screen cereals, sourdoughs and extreme acidic doughs (and other extreme factors, *e.g.* T, $a_w$) for enzymes of biotechnological interest (**WG5**). Selected enzymes will be extracted and purified and their physicochemical and biophysical characteristics determined. In addition, a global-scale gene mapping of various cereals and sourdoughs for elucidation of gene content and enzymatic repertoire will be undertaken by proteomics and transcriptomics approaches and enabling determination of its functional and microbial composition. Previous outputs (**WG1-5**) will be further used to design and develop innovative prototypes of products and small-scale processing technologies (**WG6**). New product formulations will be assayed resorting to distinct (pseudo)cereals, starter cultures, enzymes and functional compounds. As earlier mentioned, products and processes encompasses bread and baking goods but also other agri-foods, nutraceuticals, cosmetics and pharmaceuticals. Sourdough fermentation and baking tests will be undertaken to improve reproducibility between batches, flavour and aroma, texture, structure, shelf-life, nutritional, functional and health value, resistance against food spoilage and food safety. Bioreactors/fermenters and small-scale processing units will be designed and environmental and operating conditions monitored towards yield maximization. Finally, comparative evaluation of technological performance, economic viability and environmental sustainability will be carry out (**WG9**). **WG7** to **WG9** are common for both platforms (**Sch. 3**). By-products, residues and food wastes related to SOURDOMICS will be valorised through incorporation into new value chains, *e.g.* energy, agri-food and beverages, and feed (**WG7**). To that purpose distinct microbiological, chemical and separation procedures will be employed in several approaches to extract/convert, separate and purify compounds or fractions from those matrixes. As a mean to improve food quality and promote reduction of food wastes, sustainable packaging and edible films will be developed for sourdough bread and baking goods (**WG8**), using bio-based, renewable and eco-friendly materials and additives, able to extend shelf-life. Moreover, cereals, sourdough microorganisms and metabolites, and sourdough-based food will be evaluated for their impact in gut microbiome and mucosal immunity, as well as in chronic disease biology, *viz*. inflammatory bowel disease, celiac disease, obesity and cancer (**WG8**). Role of sourdough microorganisms on volatile composition and odour/aroma attributes of final food products will be assessed, as well as global sensorial perception and preference of consumers. Public surveys will contribute to understand market and consumers' behaviours, *e.g.* food market, new trends and demands, food manipulation by consumers, consumers' preferences and acceptance of novel products (**WG8**). **WG9** will contribute to sustainable future development of sourdough based value-chains. In cooperation with industrials and farmers, scenarios for sourdough-based value chains and business cases will be formulated, and LCA, PEF and EFS performed. Strategies to qualify companies and entrepreneurs will be implemented.

### 3.1.2. GANTT DIAGRAM

**SCHEME 5.** Gantt diagram (M=Milestones, D=Deliverables) accordingly to technical WGs, tasks (T), activities (A), milestones (M) and major deliverables (D) depicted in **SCHEME 4**

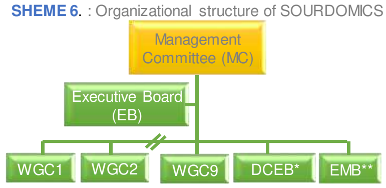
| | | Year 1 | | | | | | | | | | | | Year 2 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Month | | | | | | | | | | | | Month | | | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | **6** | 7 | 8 | 9 | 10 | 11 | **12** | **13** | 14 | 15 | 16 | 17 | **18** | 19 | 20 | 21 | 22 | 23 | **24** |
| WG1 | M1. | | | | | | 2 | | | | 1 | 2 | 3 | | | | | | 2 | | | | | 2 | 3 |
| | D1. | | | | | | 1,2 | | | | | | 1,2 | | | | | | 1,2 | 3 | | | | 3 | 1,2 |
| WG2 | M.2 | | | | | | 2 | | | | 1 | 2 | | | | | | | 2 | | | | | 2 | |
| | D.2 | | | | | | 1,2 | 3 | | | | | 1,2 | | | | | 3 | 1,2 | | | | | 3 | 1,2 |
| WG3 | M.3 | | | | | | | | | | | | 1 | | | | | | 2 | | | | | 2 | |
| | D.3 | | | | | | 1,2 | | | | | 3 | 1,2 | | | | 3 | | 1,2 | | | | 3 | | 1,2 |
| WG4 | M.4 | | | | | | 2 | | 1 | | | 2 | | | | | | | 2,4 | | | | | 2 | 3,4 |
| | D.4 | | | | | 3 | 1,2 | | | | | | 1,2 | | | | 3 | | 1,2 | | | 3 | | | 1,2 |
| WG5 | M5. | | | | | | 2 | | 1 | | | | 2 | | | | | | 2 | | | | | | 2 |
| | D5. | | | | | | 1,2 | | 3 | | | | 1,2 | | | 3 | | | 1,2 | | 3 | | | | 1,2 |
| WG6 | M6. | | | | | | | | 1 | | | | 2 | | | | | | 2 | | | | | | 2 |
| | D6. | | | | | | 1,2 | | | | 3 | | 1,2 | | | | | | 1,2 | | | | | 3 | 1,2 |
| WG7 | M7. | | | | | | | | 1 | | | | | | | | | | 2 | | | | | 2 | |
| | D7. | | | | | | 1,2 | | | | | | 1,2 | | | | | 3 | 1,2 | | | | 3 | | 1,2 |
| WG8 | M8. | | | | | | | | 1 | | | 4 | 2,3 | | | | | 4 | 2,3 | | | | | 4 | 2,3 |
| | D8. | | | | | | 1,2 | | | 3 | | | 1,2 | | 3 | | | | 1,2 | 3 | | | | | 1,2 |
| WG9 | M9. | | | | | | | | 1 | | | | | | | | | | 2,3 | | | | | | 2,3 |
| | D9. | | | | | | 1,2 | | | | | | 1,2 | | | | | 3 | 1,2 | | | | 4 | | 1,2 |

| | | Year 3 | | | | | | | | | | | | Year 4 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Month | | | | | | | | | | | | Month | | | | | | | | | | | |
| | | **25** | 26 | 27 | 28 | 29 | **30** | 31 | 32 | 33 | 34 | 35 | **36** | **37** | 38 | 39 | 40 | 41 | **42** | 43 | 44 | 45 | 46 | 47 | **48** |
| WG1 | M1. | | | | | | 2 | | | | | 2 | 3 | | | | | | 2 | | | | | 2 | 3 |
| | D1. | | | | | | 1,2 | 3 | | | | 3 | 1,2 | | | | | | 1,2 | 3 | 5 | | 4 | 3 | 1,2 |
| WG2 | M.2 | | | | | | 2 | | | | | 2 | | | | | | | 2 | | | | | 2 | |
| | D.2 | | | | | 3 | 1,2 | | | | 3 | | 1,2 | | | | | 3 | 1,2 | | | | 4 | | 1,2 |
| WG3 | M.3 | | | | | | 2 | | | | | 2 | | | | | | | 2 | | | | | 2 | |
| | D.3 | | | | 3 | | 1,2 | | 3 | | | | 1,2 | | | | 3 | | 1,2 | | 4 | | 3 | | 1,2 |
| WG4 | M.4 | | | | | | 2,3 | 4 | | | | 2 | 3,4 | | | | | | 2,3 | 4 | | | | 2 | 3,4 |
| | D.4 | | | 3 | | | 1,2 | | | 3 | | | 1,2 | | | 3 | | | 1,2 | | 4 | 3 | | | 1,2 |
| WG5 | M5. | | | | | | 2 | | | | | | 2 | | | | | | 2 | | | | | | 2 |
| | D5. | | 3 | | | | 1,2 | 3 | | | | | 1,2 | | | | | | 1,2 | | 3,5 | | 4 | | 1,2 |
| WG6 | M6. | | | | | | 2,3 | | | | | | 2,3 | | | | | | 2,3 | | | | | | 2,3 |
| | D6. | | | | | | 1,2 | | | | | 3 | 1,2 | | | | | | 1,2 | | | | | 3 | 1,2 |
| WG7 | M7. | | | | | | 2 | | | | | 2 | | | | | | | 2 | | | | | 2 | |
| | D7. | | | | | 3 | 1,2 | | | | 3 | | 1,2 | | | | | 3 | 1,2 | | | | | 3 | 1,2 |
| WG8 | M8. | | | | | 4 | 2,3 | | | | | 4 | 2,3 | | | | | 4 | 2,3 | | | | | 4 | 2,3 |
| | D8. | 3 | | | | | 1,2 | | 3 | | | | 1,2 | | 3 | | | | 1,2 | | | | 4 | | 1,2 |
| WG9 | M9. | | | | | | 2,3 | | | | | | 2,3 | | | | | | 2,3 | | | | | | 2,3 |
| | D9. | | | | | 3 | 1,2 | | | | 4 | 3 | 1,2 | 3 | | | | 3 | 1,2 | | | | 4 | 3 | 1,2 |

### 3.1.3. RISK AND CONTINGENCY PLANS

SOURDOMICS will be performed with new research efforts and findings but also with research data and outputs from previous works. In fact, all S&T WG activities will start with analysis of the state-of-the-art and case study implementation, so that a better exploitation of existing knowledge is attained. Such approach minimizes potential difficulties encountered to carry out new research activities with no funding guaranteed. Potential funding limitations will be overcome by redesigning tasks into ongoing research projects, and focus research into data and knowledge developed so far. Furthermore, network size and multidisciplinary, presence of a wide range of stakeholders, existence of ongoing research projects from COST members and proactivity in submission of projects will minimize aforementioned risks, as well as any delays in progress of work plan (**Sec. 3.1.1**). Other relevant risk, common to any networks, is the potential weak commitment of some members. Contingency plan drawn in SOURDOMICS passed by creation of a dedicated Evaluation and Monitoring Board (EMB) in addition to other organic structures and, as said before, the division of objectives into a great number of WGs.

**SHEME 6.** : Organizational structure of SOURDOMICS

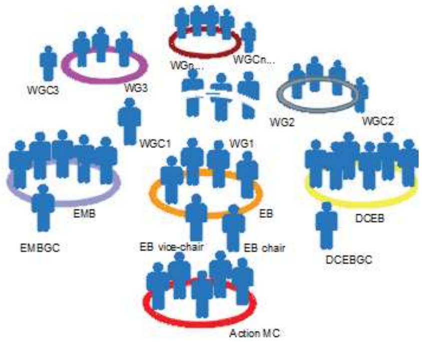



*DCEB: Dissemination, Communication and Exploitation Board
**EMB: Evaluation and Monitoring Board

## 3.2. MANAGEMENT STRUCTURES AND PROCEDURES

Organic structures of SOURDOMICS are depicted in **Sch. 6-7**. **Action MC** will be in charge of management, administrative and scientific coordination (**Sch. 2**). Tasks will encompass: (***1***) Overall (S&T and financial) project coordination; (***2***) Management and communication; (***3***) Quality assessment; and (***4***) Official reporting and liaison between Action MC and COST Association. MC will elect the Executive Board (EB), DCEB, EMB and WGs, and supervise, monitor and give them recommendations. It will also address diverse issues with external bodies, and include new members in network. **EB** will be composed of elected members from MC, and will comprise a Chair, Vice-Chair, WGCs, and DCEB and EMB members. EB will monitor COST Action. Moreover, COST Action network will be divided into clusters – the (dynamic and adjustable over time) **WGs** – according to objectives of SOURDOMICS. Each WG will have a rotating coordinator (WGC), elected in first MC meeting and annually. In addition, task leaders will be elected during first kick-off WG meeting. Quarterly online WG meetings chaired by WGC will monitor progress and performance of activities and eventually take corrective actions. Simultaneously, **EMB** will be created as a body external to WGs to better evaluate and monitor progress of work plan. EMB will comprise a General Coordinator (EMBGC) and 5 Coordinators (EMBCs) elected from MC at first MC meeting. Synergy between EMBCs and DCEBCs and WGCs will be designed to ensure a proper communication and engagement among COST members in each and between WGs, and also with external stakeholders, while guaranteeing the smooth monitoring and running of envisaged activities according to work plan and timelines (**Sch. 4-5**). As stated before (**Sec. 2.2.2**), **DCEB** will be formed by 1 DCEBGC, 4 DCEBGC, 1 EC and 1 webmaster (elected from MC at first MC meeting). Frequent teleconference meetings will be a key element to the success of SOURDOMICS.

SCHEME 7. Representation of organic structure of SOURDOMICS




## 3.3. NETWORK AS A WHOLE

SOURDOMICS network consists of 29 COST Country Institutions, 2 NNCs and 10 COST International Partners, with 55.2% of ITCs. It possesses a good balance of gender distribution (54.1% females), core-expertise of proposers and early-senior investigators ratio, and comprises participation of all Continents. Within proposers, 14 are SMEs/LEs and 45 higher education/associated organisations. Main challenge of this COST Action (**Sec. 1.1.1**) is to exploit cereal and sourdough technology by gathering current S&T knowledge and enabling breakthrough discoveries. Specific aims were setup based on such challenges (**Sec. 1.2**). Therefore, only a multi- and interdisciplinary and broad cross-border network with a transnational coordination could be significantly representative of current state-of-the-art and S&T community. Since community of cereal and sourdough researchers and technologists is expressive all over the world, inclusion of a large nº of geographically representative countries in consortium occurs naturally. Besides, the greater the diversity of researchers and stakeholders, the greater the awareness of needs and the greater the diversity of applications will be generated. As stated in COST philosophy on impact, "*Some ideas only have the biggest impact in a context which is economically, socially and geographically different from the place where it originates*". Furthermore, SOURDOMICS has a strong focus in revisiting and exploiting acquired knowledge, thus it was important to bring to consortium senior researchers with recognised merit alongside with younger researchers to provide continuity and new spotlights. Conversely, to develop new products/processes with a broad spectrum of applications and to meet actual Societal Challenges, it is essential involvement of stakeholders within value-chain, from farmers to consumers. Presence of a large nº of countries will also become an effective vehicle for dissemination and exploitation of results. Finally, presence of an extensive nº of researchers, farmers and companies will enhance critical mass and facilitate sharing of different areas of knowledge, human resources, equipment and infrastructures – benefiting efficiency. In this sense, this COST network may also become an important booster to ongoing research projects of COST members and to submit new projects. For these reasons, this COST Action network meets, as a whole, all requirements to address proposed challenge and specific objectives through open and bottom-up activities. It will be a bridge between several R&I communities scattered worldwide towards promoting and spreading Excellence.

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