

DossierTècnic

Innovation and knowledge transfer

June 2022



Generalitat de Catalunya
Departament d'Acció Climàtica,
Alimentació i Agenda Rural



**Operational
Groups
in Catalonia.
Call 2017**

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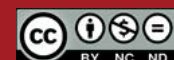
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Oriol Anson Fradera
Rural Agenda Secretary

Operational Groups in Catalonia in the new Common Agricultural policy

As we approach the end of the current CAP and the current programming period of the 2014-2022 Rural Development Programme, it is time to start talking about the future. To talk about the new CAP, the new Common Agricultural Policy Strategic Plan for 2023-2027 (CAPSP), the needs we face and the challenges we must overcome.

Soon we will begin a new era with new rules and a major objective that we must not lose sight of: sustainable rural development and the fight against climate change. The means to achieve those ends will be all the actions included in the new 2023-2027 CAPSP. However, that this will not be the only objective of the coming period, as other objectives will also have to be met, which although they are not of equal importance, are just as important for achieving the rural growth we want: a rural world that is competitive, resilient, with opportunities for young people, with equality between men and women, providing employment, which safeguards bio-

diversity and natural resources, and produces high quality food.

This framework of objectives includes the new project by the European Innovation Partnership for agricultural productivity and sustainability. This is a very important initiative which will have a broad-based and positive impact in terms of meeting all the objectives mentioned above. This intervention is not new in Catalonia, as the first call took place in August 2015. Thanks to the experience gained and all the knowledge that the sector and the actors in the rural world have passed on to us, we hope to be able to establish a successful and valuable mechanism to achieve our objectives and meet rural demands once again.

The new Operational Groups initiative will aim to support projects that foster innovation in the agrifood and forestry sector, modernise the sector and promote the sharing of knowledge and the digitalisation of rural areas. This is all focused on creating a rural environment which is capable of producing in a more sustainable, cooperative and environmentally friendly way. The aim is therefore to enhance training and advisory services, while reinforcing the links of cooperation between actors in the rural world.

The new Operational Groups initiative is being carried out with Agricultural Knowledge and Innovation Systems (AKIS) in mind. These systems seek to promote flows of knowledge between public bodies, producers, advisors, training centres and in general any actor related to the agrifood sector, and to foster cooperation between them for the development of a competitive and sustainable agriculture.

However, the new 2023-2027 programming period includes major new features. The major change is the structuring of the entire CAP Strategic

Plan within a single plan and the establishment of specific regional characteristics in an annex. In the case of Catalonia, these specific characteristics have been drafted taking into account the experience of the public sector that administers it and the needs expressed by the sector and the main parties involved in the rural world, such as associations and other stakeholders. It has led to the creation of an initiative that in addition to the above, will not only take into account the primary sector, but also all the key actors in the value chains, and will focus on the production, agrifood and forestry sectors. It will also include a type of operation which will be the creation of added value and innovation in the agrifood and forestry industry to complement agricultural and forestry practices. A total budget of fifteen million euros have been allocated to this measure, which is anticipated to be spread over four calls: two calls for pilot projects and two calls for writing projects.

We hope that the new CAPSP 2023–27 and the measures within it will bring us as much or more knowledge than the current period has brought us, that we will be able to face all the challenges ahead, and work together to achieve rural development consistent with the future prospects of each of the actors and people who are part of it.

Finally, we would like to emphasise the importance of operational groups as crucial actors in agrifood and forestry innovation. These groups have worked unceasingly to achieve a sustainable production model that is more environmentally friendly. We are aware of the difficulties that this entails, and we would like to thank everyone involved for the effort and enthusiasm they have shown over the last few years, and to encourage them to continue innovating collaboratively in the coming years.

THE COMMON AGRICULTURAL POLICY STRATEGIC PLAN 2023–2027

Operational Groups

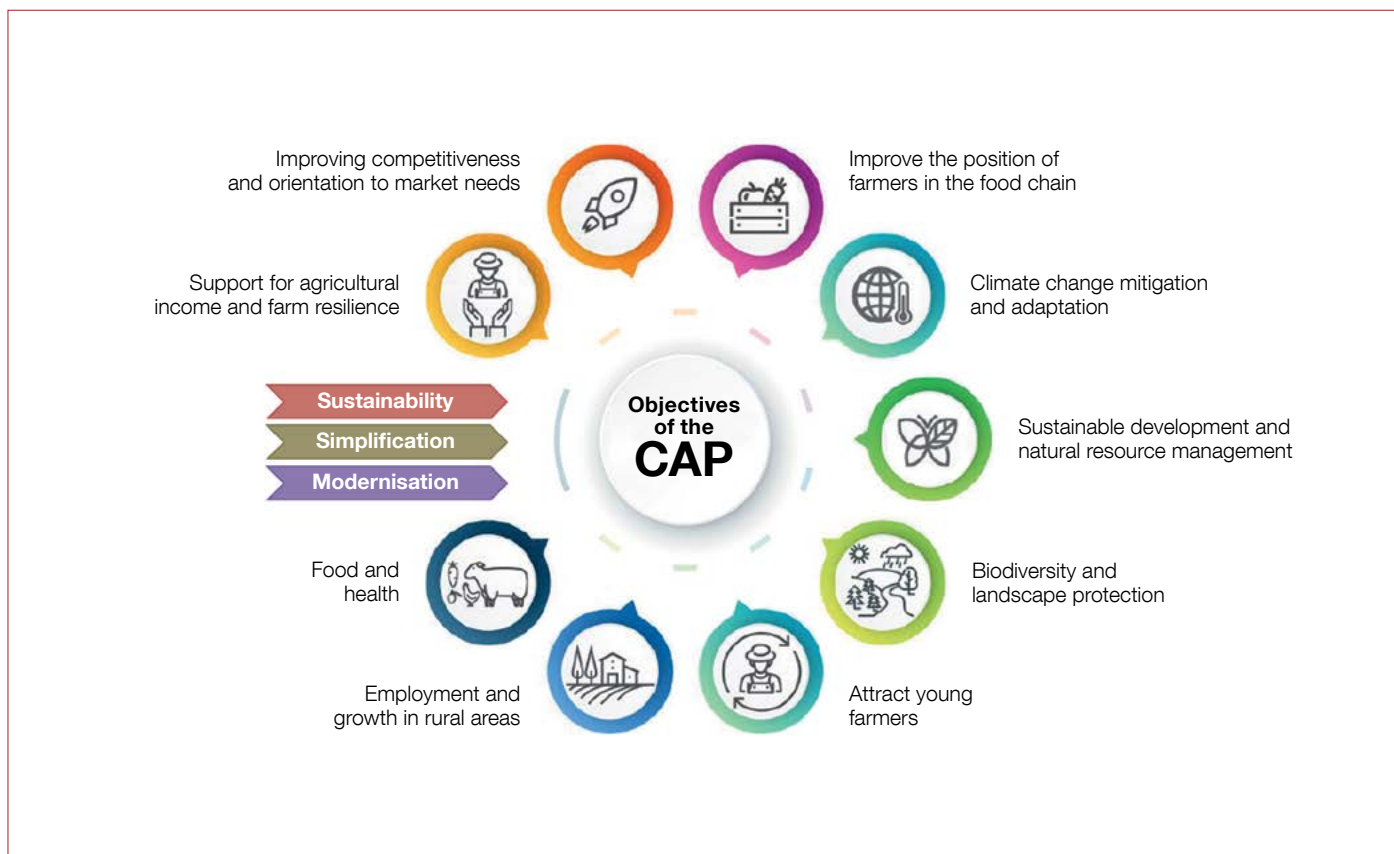


Figure 1. Specific objectives of the 2023-2027 CAP. Source: DACC.

01 Introduction

The European Regulation establishing the new Common Agricultural Policy (CAP) for the period 2023–2027 was published on 6 December 2021. The new legislation aims for a fairer, greener and results-based CAP, which aims to ensure that European agricultural and livestock farmers have a sustainable future, and which gives Member States more flexibility to adapt its measures to their territories.

One of the main aspects of the new policy is the introduction of strategic plans

at Member State level, so that governments can tailor their interventions to agricultural needs and in cooperation with regions and stakeholders. These strategic plans will include each Member State's CAP implementation model for both the first and second pillar and in Spain, it will replace the current rural development programmes at the level of each Autonomous Community.

The new Regulation is also more ambitious from an environmental point of view, as the new CAP provides support for both the Farm to Fork strategy and the Biodiversity Strategy for 2030,

which both fall within the European Green Deal, and it must also be aligned with the objectives of the 2030 Agenda for Sustainable Development. The CAP Strategic Plan is designed around a new "green architecture", which is based on enhanced conditionality, ecoregimes in the first pillar, and environmental commitments in the second pillar.

According to the European Regulation, the CAP Strategic Plan must have nine specific objectives and one broad-based objective, divided into three areas: economic, social and environmental (fig. 1).

A fairer CAP

The CAP will include social conditionality for the first time, meaning that CAP beneficiaries will have to respect elements of European social and labour law to receive CAP funds.

Redistribution of income support will be mandatory. Member States will redistribute at least 10% to the benefit of smaller farms, and must describe in their strategic plan how they plan to ensure that direct payments are distributed more equitably.

Support for young farmers will have a new mandatory minimum level of 3% of Member States' budgets for CAP

The Common Agricultural Policy (CAP) will include social conditionality for the first time: Those receiving CAP funds must respect elements of European social and labour law.

income support to young farmers and those taking over farms. This could cover income support, investment or start-up aid for young farmers.

A greener CAP

The new CAP will support the transition towards more sustainable agriculture with increased ambition for climate, environment, and animal welfare, by means of new tools.

- Consistency with the European Green Deal to fully integrate EU environmental and climate legislation. The plans will contribute to the targets of the Farm to Fork and Biodiversity Strategies, and will be updated to take into account the changes in climate and environmental legislation.
- Conditionality, or the minimum requirements that CAP beneficiaries must comply with in order to receive support, will be more ambitious.
- Ecoschemes are introduced on a mandatory basis for Member States, which must allocate at least 25% of their income support budget to these schemes. This new voluntary

For a greener CAP: ecoregimes are introduced on a mandatory basis for member states, and on a voluntary basis for farmers. The latter will be rewarded if they implement environmentally friendly climate practices.

instrument for farmers will reward them for implementing climate and environmentally friendly practices. Table 1 shows the ecoregimes proposed in Spain.

- At least 35% of rural development funds, defined by the autonomous communities, will be allocated to environmental commitments promoting environmental, climate and animal welfare practices and other measures with environmental objectives. These measures are defined by each Autonomous Community and must include support for organic agricultural production as one of the main measures.

Ecoregime	Objectives	Core practices
Increase carbon sink capacity and enhance biodiversity in wet grassland (EE1) and Mediterranean grassland (EE2) areas	Improve soil structure, reduce erosion and desertification, increase carbon content, reduce emissions and improve biodiversity	Encourage sustainable extensive grazing and reaping, and promote the creation and maintenance of islands of tree and shrub vegetation as a refuge for biodiversity in grasslands
Ecoregimes in rain-fed (EE3), dry (EE4) and irrigated (EE5) croplands	Promote biodiversity associated with agricultural areas, and the conservation and quality of natural resources, water and soil.	Encourage crop rotations with crop-improving species, and conservation agriculture and direct sowing.
Ecoregime of woody crops on flat land (EE6), on medium slopes (EE7) and on steep slopes (EE8)	Improve soil structure, reduce erosion and desertification, increase carbon content and reduce emissions	Promote green covers and/or inert covers
Biodiversity hotspots in arable and permanent cropland (EE9)	Promote biodiversity associated with agricultural areas	Promote the maintenance of non-productive areas in good condition as a refuge for biodiversity

Table 1. Ecoregimes proposed in the National Strategic Plan. Source: MAP 2022.

In overall terms, 43% of the total budget of the National Strategic Plan will contribute to environmental and climate ambition.

A performance-based CAP

The focus on results of the new implementation model requires a robust performance framework which will involve annual and multi-annual assessments based on output, outcome and impact indicators, in line with the provisions of the Performance, Monitoring and Evaluation Framework.

States must monitor progress and report annually to the Commission as part of the performance monitoring and evaluation framework. The information provided will be the basis on which the Commission will report on the progress made towards the achievement of the specific objectives over the entire period. The new CAP will therefore undergo constant review and revision.

The new PAC will be subject to ongoing review and revision.

Boosting knowledge, research and innovation

Advancing in research, knowledge sharing and innovation will be essential for ensuring a smart and sustainable agricultural sector. As part of its commitment to supporting research and innovation in agriculture, the Commission has proposed to allocate €10 billion from the Horizon Europe programme to projects related to food, agriculture, rural development and the bio-economy.

The reformed CAP will benefit from this increased investment, and will incorporate stronger agricultural knowl-

edge and innovation systems (AKIS) to foster the development of innovation projects, disseminate their results and encourage their use as widely as possible. Farm advisory services will become a key tool for sharing new knowledge and ideas.

Next steps

After the European Commission has carried out the evaluation process of these plans, the CAP Strategic Plan (CAPSP)

is expected to be approved in 2022 and will enter into force on 1 January 2023.

02 EAFRD interventions in Catalonia

As can be seen from the importance of the environmental commitment in the coming period, the new CAP Strategic Plan 2023-2027 will consist of a wide range of environmental interventions, including the support package based on environmental and animal welfare



New environmental and nutritional model at broiler chicken farms to reduce non-infectious lesions. Photo: Agrobaiona, SL.



Bovine livestock waste recovery and reuse. Photo: La Fageda.

commitments, involving a total of 9 lines of support: commitments on sustainable crops, sustainable pastures, sustainable beekeeping, protection of birdlife, improvement and maintenance of habitats, alternative systems to chemical control, organic agricultural production, improvement of animal welfare, and conservation of genetic resources. However, these measures will not be the only ones to be taken into account when assessing environmental ambition, as the Plan will

contain other projects benefiting the environment and sustainability, including forestry investments, productive investments in climate change mitigation, non-productive investments in the natural environment and finally, compensatory allowances for areas facing natural constraints.

Moreover, in order to respond to the broad-based objectives of the next CAP, priority will be given to all projects aiming to improve the exchange and

transfer of knowledge from research to its practical application. The main actors in this area will be the operational groups, which will be instrumental in drafting and implementing projects within the framework of the European Innovation Partnership.

In the other regional measures of the 2023-2027 CAPSP in Catalonia, priority will be given to aid linked to improving competitiveness on farms, measures related to the Leader methodology, and recruiting young farmers. Young people and generational change will therefore continue to be a cornerstone in the new period, in which work will be done to create an intervention that promotes high quality employment opportunities, reverses the depopulation of rural areas and is at the same time an initiative that promotes gender equality between men and women.

03 The operational groups in the new CAP

Major new characteristics

Among the new characteristics of the new CAP and the new Operational Groups measure, the Agricultural Knowledge and Innovation Systems also play a major role. Member States will have to detail how advisory and innovation services for the Operational Groups will be provided in their CAP Strategic Plan, and all their advisers will have to be integrated within the AKIS system. The knowledge and innovation created by the Operational Groups must also contribute to the broad-based objective, and thereby contribute towards the nine specific objectives. The projects will therefore have to address cross-border issues and will have to focus on the practical needs of farmers, complementary knowledge, co-creation and co-decisions throughout the project.

Digitalisation is also very much a broad-based feature of the new CAP, and specifically the cooperation and



DURCAT. Application of fungicide treatments to durum wheat. Photo: Panificadora Alimentària SL.



WETWINE: innovations in the application of constructed wetlands at wineries Photo: Celler La Vinyeta.

innovation package, with the aim not only of modernising the rural world and the knowledge that it brings, but also of moving towards a more modern CAP.

The Operational Groups will have to undertake innovative projects based on an interactive model of innovation that seeks to maximise the knowledge of their members by focusing on the needs of farmers.

Digitalisation is also very important as a broad-based characteristic of the new CAP, and specifically in the cooperation and innovation package.

The Operational Groups must carry out innovative projects based on an interactive innovation model that focuses on the needs of farmers and seeks to maximise the knowledge of their members.

In a manner consistent with the results-based form of the new CAP, the Operational Groups will have to disseminate their plans and the results of their projects in order to foster collective knowledge and improve access for all citizens.

Operational Groups in Catalonia 2023-2027

At the regional level, the Operational Groups in Catalonia must go far beyond innovation in the primary sector. It is therefore crucial that interventions in the coming period focus on

the productive sector, as well as on the agrifood sector and the forestry sector.

It is also essential that while focusing on the broad-based objective of the new CAP, the projects include some added value in the innovations in order to confer an added quality on everything that emerges from them. This should be possible by using all available sources of knowledge and by considering the agrifood industry and the forestry sector as complementary sources of knowledge for enriching the Operational Groups, which can draw on the experience of these actors. In line with this objective, the aim is to create a broad intervention that is open to all the relevant stakeholders in order to achieve modern and environmentally sustainable rural development. It is anticipated that the beneficiaries of the income support will be many and varied, and range from agricultural and forestry producers and their associations to companies in the agrifood sector, irrigation communities, craftsmen and their guilds, Local Action Groups (LAGs) and clusters related to the agrifood sector.

The Operational Groups must be one of the main tools through which the AKIS achieve the objectives of the new CAP, and respond to the needs of the sector and the rural world in order to create a production sector with enhanced agricultural training and high levels of fluidity in the exchange of knowledge with a view to the 2027 horizon. A more digitised sector in accordance with its needs must be created, with good AKIS governance structures and a strong structure of advisers supporting the entire sector. In short, the aim is to create a rural environment which will progress towards a green and digital transition, which is accessible to everyone and with knowledge and its transfer at the centre, through innovation in its productive sector.

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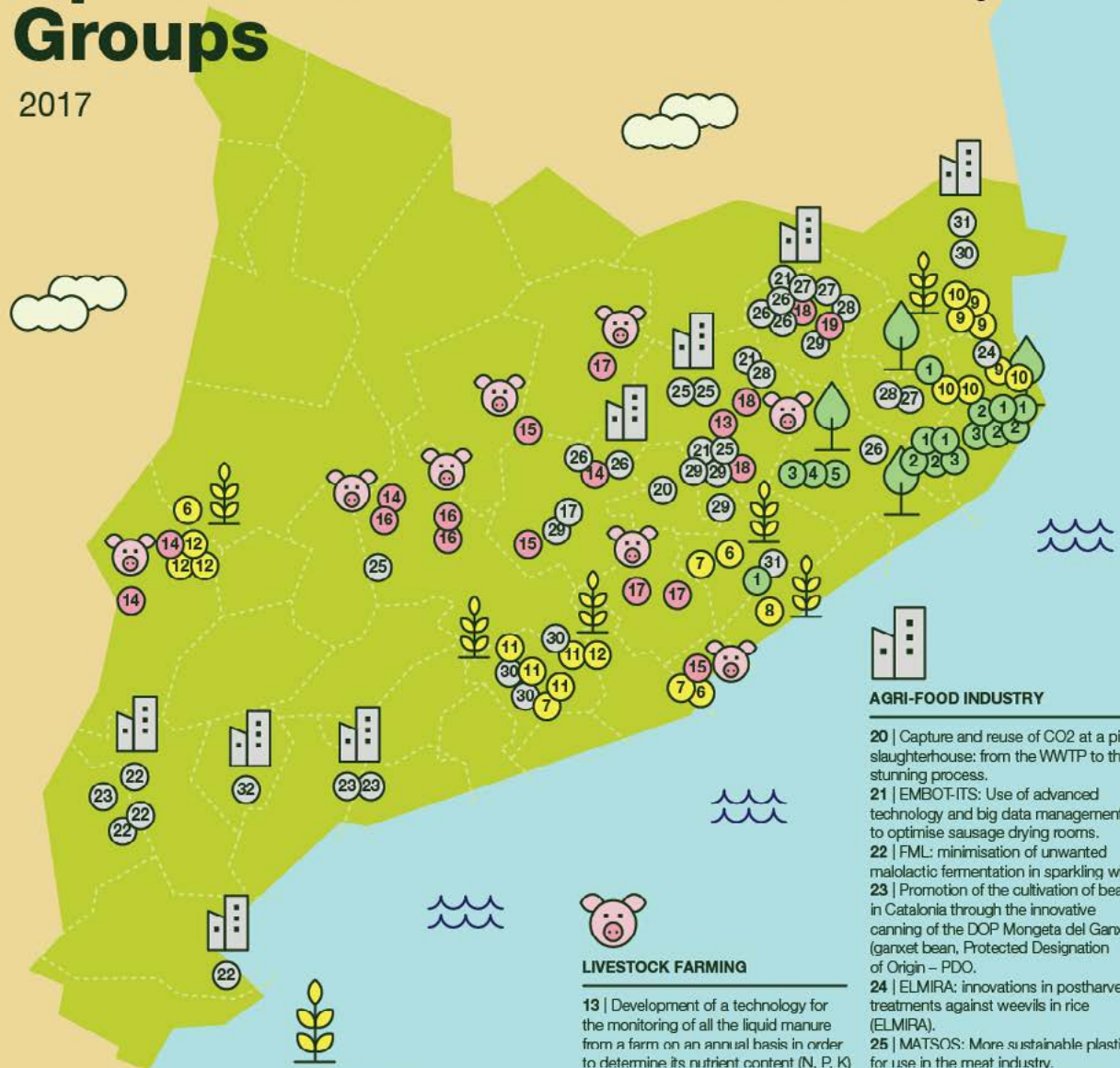
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Operational Groups

2017

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FORESTRY

- 1 | Development of a system to remove TCA from cork stoppers using adsorbents and biosorbents.
- 2 | Evolution of oxygen transfer in the various cork stopper manufacturing conditions. Effect of this parameter on still and sparkling wine.
- 3 | LOGGFORGAT: Development of an efficient logging system using the LOGGFORGAT boom harvester.
- 4 | Production and use of 'zero-kilometre' substrates in nurseries.
- 5 | SISE: Innovative silo for the supply of wood chips.



AGRICULTURE

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1

Development of a system to remove TCA from cork stoppers using adsorbents and biosorbents

Leader:

Francisco Oller, SA

Other recipient members:

Juan Costa Quer, SA, De Maria Taps, SL, J. Vigas, SA, Taponés y Especialidades del Corcho, SA

Coordinator:

Foundation for the Promotion of the Cork Sector

01. Rationale

The manufacture of stoppers is currently the application with the highest added value for cork as a raw material. Ninety-eight per cent of the Catalan cork sector's turnover comes from the manufacture of stoppers for still and sparkling wine. Its turnover is around 230 million euros, its export rate is around 50%, and it employs more than 1,200 workers. Although it is a high-quality product, the challenge is to remove the sensory deviations that it can create, which would make it possible to address the threat posed by alternative stoppers that have recently become available on the market, partly as a result of the controversy arising from the presence of haloanisoles (including TCA) and other volatile compounds that may be present in the cork, and affect the final bouquet of the wine. This has forced the cork sector to implement technologies for the detection and removal of these aromatic compounds.

There are aroma removal systems currently available on the market, but they are primarily intended for cork granules and not for the manufacture of stoppers, as they are "aggressive" removal systems that may affect the cellular structure of the material. The system that this operational group intends to study is based on the use of adsorbents and biosorbents that can retain the aromas extracted during the various stages of cork production. This innovative method will increase the competitiveness of cork companies, and enhance the use of natural and renewable products such as cork stoppers.

02. Results and conclusions

The end result of the project is two aroma removal systems - one for the natural cork stopper manufacturing process and the other for the agglomerated cork stopper manufacturing process, with two discs for sparkling wine under liquid and steam conditions. A mixture of biosorbents of natural origin has been obtained, which

captures between 50-95% of haloanisoles under laboratory conditions. This system is based on adsorbent compounds with a greater affinity for aromas than cork, enabling an increase in their removal without entailing major changes to the systems currently used by the companies.

The project has led to a number of practical recommendations. The first is that titrated activated carbons are a good alternative for removing defective aroma compounds in cork stoppers. The selected materials can also be applied in both aqueous and dry environments, and their shelf life is more than 6 months. Application of these compounds in company extraction systems improves their efficiency.

Significant potential has been found in the use of biosorbents at different points in the wine production process for reducing unwanted aromas in cork stoppers, and it can also be adapted to each company's needs. Further work is still needed on the design of biosorbent containment prototypes in order to solve the challenge of biosorbent containment without limiting the adsorption properties of the biosorbents.



2

Determining oxygen permeability under different conditions in cork stopper manufacturing and the effect of this parameter on still and sparkling wine

Leader:

J. Vigas, SA

Other recipient members:

Manuel Serra, SA, Francisco Oller, SA, Taponés y Especialidades del Corcho, SA

Coordinator:

Foundation for the Promotion of the Cork Sector

01. Rationale

The stopper's oxygen supply, known as oxygen permeability or Oxygen Transfer Rate (OTR), is one of the variables with the greatest effect on wine's development when it is in the bottle. Cork stoppers are considered to have a considerable advantage over their alternatives thanks to their plant matrix, as they allow oxygen to gradually enter the bottle over time, preventing oxidation and reduction.

The project consisted of determining the variables in the cork stopper production process that affect oxygen transfer, and obtaining information with a view to modifying the production procedure in order to adjust the oxygen transfer rate of the corks in accordance with the values agreed for each type of wine. This will also enable control measures to be applied, and the effects of permeability on the oxygen in the wine to be determined.

The initiative also aims to lead to the production of a catalogue of cork stoppers with different permeabilities, which will show the customer their specific implications for the development of the wine. This will lead to enhanced relations between the cork and wine sectors, which will bring financial benefits to both.

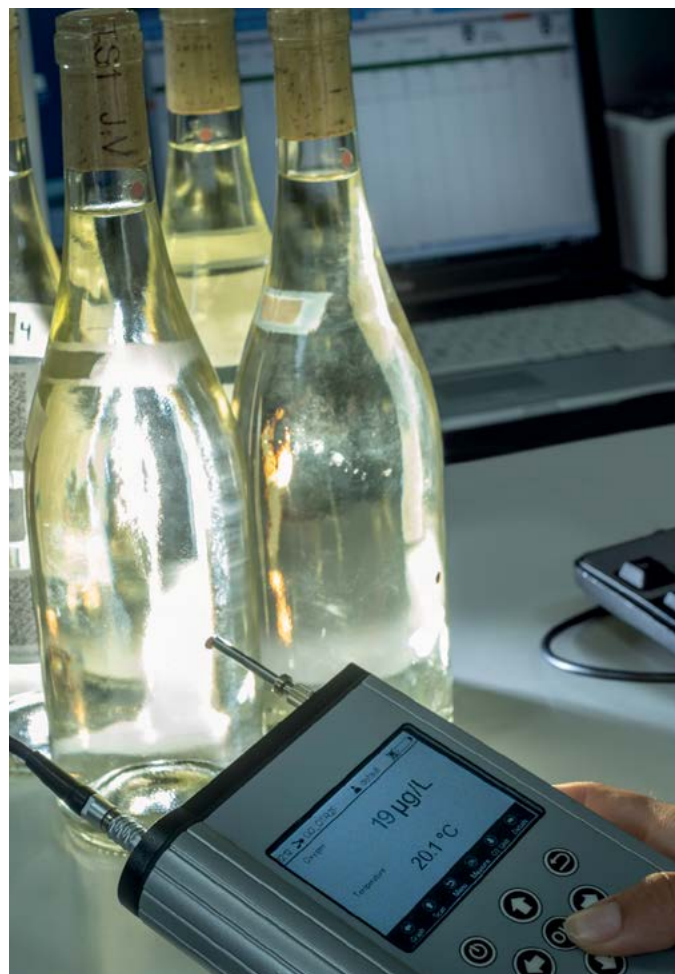
02. Results and conclusions

The study provided an innovative method for measuring the permeability of cork stoppers throughout the manufacturing process. This protocol shows the oxygen permeability values of the different types of stoppers under conditions very similar to those produced non-artificially. This allows cork companies to supply more uniform products that can compete with alternative types of stoppers.

It was also possible to determine the relevant factors affecting oxygen permeability during the entire stopper manufacturing process. Further characterisation of the different variables that affect the final OTR values of the cork stoppers should be carried out in order to guarantee the maximum quality of the final product, especially bearing in mind that this is an opportunity to reinforce the relationship between wineries and cork stopper manufacturers. The evolution of wines with longer evolution times is another factor that needs to be analysed further.

As regards stopper manufacturers ensuring the uniformity of their stoppers according to the OTR variable, it is necessary to take the different production processes into account. More critical points or factors in the production process that may influence the permeability of the stopper must be identified in order to define and monitor the most sensitive production processes.

The oxidative capacities of each wine vary depending on numerous parameters, but winemakers and wineries know how long they want their wines to last. Synergies must be created between the winery and the stopper manufacturer to find the most appropriate cork-wine combination in each case. The oxygen transfer rate variable and the type of wine to be corked are essential factors in selecting the type of stopper that is suitable for their product.



3

LOGGFORCAT: development of an efficient logging system using the LOGGFORCAT boom harvester

Leader:

Estrats de Bosc, SL

Other recipient members:

Forestal Riudecos, SL

Other non-recipient members:

Forest Sciences and Technology Centre of Catalonia (CTFC)

Coordinator:

Robert Rosell Pagès

01. Rationale

LOGGFORCAT is a project that has created an innovative logging system based on the construction of a prototype of a 15-metre telescopic arm with a grappling hook. This device enables the trees cut down at the trackside to be logged in an agile way thanks to its ability to stack them according to the loading requirements of forestry trucks, improving yields, reducing the environmental impact and increasing safety in forestry work.

The project has several specific objectives. First, to modernise the logging system for wood products. Improving the production

system of forest biomass for the production of renewable energies reduces the environmental impact, and the economic results of forestry operations can be increased beforehand.

The initiative also aims to promote the use of forestry biomass, which would consolidate the forestry sector in the energy production field. Facilitating the supply of forest biomass by means of these new technologies that improve efficiency and reduce the workload creates a demonstrative effect and transferability of its effectiveness as a renewable energy.

02. Results and conclusions

After carrying out all the tests, the LOGGFORCAT boom harvester has been shown to improve the economic performance of the farm, largely because it is three times faster than a tractor with a winch. In addition, the boom harvester emits half the emissions of the tractor when harvesting timber, demonstrating its environmental sustainability.

The working ergonomics and safety of forestry operators have increased due to the use of this new system. In addition, there is a considerable improvement in financial terms as crane trucks reduce costs of loading the wood, as they do not have to pick it up along the road but instead in the piles prepared by the boom harvester.

The LOGGFORCAT logging system also undertakes logging and sorting simultaneously, which improves throughput and helps to add value to the product. Impacts on the soil and erosion problems, and the uprooting or wounding of stumps due to impacts with logs being dragged have also been greatly reduced.



4

Production and use of 'zero-kilometre' substrates in nurseries

Leader:

Belloch Forestal, SL

Other non-recipient members:

SAT 605 CAT, Xurri Terres Vegetals, IRTA

01. Rationale

The development of substrates for the production of plants is the main objective of this operational group, organised and coordinated by the company Belloch Forestal, SL, which has determined the technical, economic and environmental viability of the process involved in obtaining these materials. The process also aims to create a circuit based on the circular economy.

The objectives of this project can be summarised as follows:

- To produce substrates based on forestry waste generated on the Belloch estate, on an industrial scale and around the nursery, complemented with by-products that are richer in nitrogen (N) or other fibrous materials from nearby sources.
- To assess the properties of these compounds obtained with regard to their use as substrates, and to determine the optimal composition of the final mixtures. These mixtures will be applied to a tree crop under nursery conditions, and the best fer-

tilisation and irrigation conditions shall be studied.

- To analyse the process of obtaining and using substrates from an environmental perspective, and to determine their technical and economic viability.
- To disseminate the results of the project and provide the nursery staff with the knowledge they need to adopt techniques for monitoring the production system related to the use of the new substrates.

02. Results and conclusions

The study of complementary raw materials that make up the final mixtures has shown that their nitrification can be increased on a large scale. This would enable intensified acidification of the material. Satisfactory results have been obtained, despite some unfavourable weather conditions in the area.

It has also been possible to produce indigenous substrates based on forest wastes, which have characteristics making them suitable for use as substrates for crops. Their use in a tree crop for a few months has produced acceptable results; however, longer-term studies must be carried out to determine the most suitable mixtures which avoid the material declining in volume during cultivation as much as possible.

The economic viability of substrate production in close proximity has been demonstrated. Costs are reduced by using low-cost raw materials obtained in the vicinity of the composting plant and the nursery. In environmental terms, the need for local composting of by-products and more extensive monitoring of emissions during the process to minimise them was highlighted.



SISE: Innovative Woodchip Supply Silo

Leader:

Sala Forestal, SLU

Other non-recipient members:

Forest Sciences and Technology Centre of Catalonia (CTFC), Polytechnic University of Catalonia (UPC)

01. Rationale

The SISE (Silo Innovador para el Suministro de Estella) platform, is an automated logistics storage facility for the distribution of high quality woodchips. Optimising its biomass distribution chain means that this product can be taken anywhere in the territory, while reducing the CO₂ footprint that it would create during transport under normal conditions.

The SISE platform operates unmanned thanks to an automation system that means that the transporters can work with no need for any other supervisory person when both loading and unloading woodchips. The automation of the platform provides significant flexibility in wood chip delivery times to customers' silos, as it only depends on local carriers unloading over short distances.

Automation and personnel shortages on the SISE platform have made it necessary to develop a monitoring system that is capable of anticipating demand management. This has been made possible by machine learning based on the data obtained from the distribution of woodchips to customers. The flow of transport, which keeps the silo supplied with the required amount of woodchips at all times, has thereby been optimised.

The following objectives must be achieved in order to carry out this monitoring on an optimal basis:

- Build an innovative prototype for the supply of forest woodchips
- Analyse how the demonstration prototype works.
- Optimise the distribution of the forest wood chips.
- Evaluate the impact of the project and disseminate its results.

02. Results and conclusions

The results have shown a reduction of more than 110% in CO₂ emissions with this new logistics distribution model. By using biomass as a fuel, it not only reduces greenhouse gas emissions but also minimises the dependence on external energy. This improves the security of the supply and internalises the energy bill, enabling sustainable forest management.

The SISE system has been proven to ensure the regular supply of uniform woodchips. The time when the supply of timber is at its strongest, coupled with the 9-month drying period, is not usually when the demand for wood chips is highest in a territory, which is normally during the coldest periods of the year. With SISE, the biomass reaches the end customer's silo with a lower CO₂ footprint, assurance of high quality levels, and fast turnaround on orders. This provides an incentive to increase the number of potential customers who would not otherwise consider using biomass as a fuel. This contributes to meeting the penetration targets for renewables that have been set in Catalonia.

Finally, the study has provided a great deal of data on the quality of woodchips and their consumption in real time. This knowledge was previously completely unavailable outside the world of academia.



6

DURCAT: meeting the demand for durum wheat through local production with low environmental impact, short distribution chains and total traceability

Leader:

Productos Alimenticios Gallo, SL

Other recipient members:

Cereales Aragón y Cataluña, SA

Other non-recipient members:

Catalan Association of Seed Multipliers (ACML),
Associació de cooperatives de les Terres de Lleida,
SCCL, Professional Young Agricultural and Livestock
Farmers, IRTA

Coordinator:

Ipa Capital, SL

01. Rationale

The introduction of durum wheat in Catalonia is the primary objective of this initiative, which aims to meet the demand for this type of crop from the Spanish pasta industry. In order to implement a production model focused on quality and which encourages a short distribution chain, DURCAT aims to focus this product as a new value-added alternative for the Catalan cereal production sector.

The project has a number of specific objectives. First, to determine the productive and qualitative potential of durum wheat in Catalonia by identifying the varieties that are best suited to each growing area. Second, to be able to apply innovative tools based on remote sensing and sensorization, which help with making decisions regarding the environmentally friendly and economically sustainable production of high quality grain. The aim is to create an integrated short-chain model with distribution from the farm to industry. The final aim is to assess the environmental and economic impact of the proposed production model.

The agro-climatic zones in which the cultivation of durum wheat could be feasible were identified in order to establish its produc-





tion potential, and a study was carried out to determine its economic viability in Catalonia based on the results of the yields obtained in each agro-climatic zone in each season. The application of the innovative tools mentioned above to help decision making was also analysed and used in plots located in Sucs, where the performance of various irrigation systems had been studied in 2019. The life cycle analysis of wheat was carried out to quantify the environmental footprint of dry pasta production.

02. Results and conclusions

The study provides results for all the aspects analysed, and it has been possible to draw the necessary conclusions on the viability of durum wheat cultivation in Catalonia from those results. The specific conclusions include the following:

- The production yields are very high in agricultural areas with very diverse characteristics, which demonstrates these crops' adaptability to different areas in the territory.
- The excellent quality of the durum wheat obtained during the 2019 season showed that it is possible to produce durum wheat of the highest quality in Catalonia thanks to proper irrigation and surface nitrogen fertilisation cover.
- The use of multispectral and thermal remote sensing, supported by energy balance models, made it possible to determine the height of the plants, the fraction of vegetation cover, the leaf area index (LAI), crop evapotranspiration and transpiration, and relate them to production variables. These tools have also enabled the implementation of irrigation strategies adapted to each stage of the crop, and for the selection of varieties adapted to irrigation restrictions.

- If the domestic demand in Catalonia were to be lower than at present, high-quality durum wheat could be sold to the Aragonese semolina industry if it is applied with an economic criterion of proximity. In any case, it is a crop that requires a commitment to implementation with a more demanding technical itinerary from the primary sector compared to the production of more rustic cereals.
- The quality of the wheat obtained means that the durum wheat produced in Catalonia can either be included in the cereal mixtures distributed by large producers, or create a segregated chain of durum wheat-based products with total safeguards of traceability and the agricultural seal of proximity.

However, there are still some parameters that require further study in order to draw definitive conclusions. The major climatic differences between the two seasons evaluated prevented us from obtaining results that would enable us to reliably identify the best durum wheat varieties for each agro-climatic zone. From an environmental point of view, the range of results obtained in terms of production and economic management is too wide, but the irrigation system used appears to be decisive in this respect.

Finally, the study shows that Catalonia cannot currently achieve self-sufficiency in durum wheat production, as to generate 150,000 tonnes per year, the crop have to be planted in areas where the climate and soil conditions are unsuitable. However, a production level of 10,000 to 12,000 t/year is an entirely feasible objective, and would bring added value to the primary sector and have a very easy outlet to the market.

7

Irrigation management and mycorrhization in horticultural crops

Leader:

Agrícola Maresme s. XXI, SAT

Other recipient members:

Semillas Fitó, SAU

Other non-recipient members:

ARREU, IRTA

Coordinator:

IRTA

01. Rationale

The need to reduce water input to the crop without losing competitive productivity is a major challenge for agriculture, and for intensive horticulture in particular. This project aimed to meet this need. Using a tomato crop as a testing ground, various strategies for action were developed to achieve the objective of reducing irrigation regimes.

The initiative focused on two main areas to meet this objective. The first is based on combining innovative irrigation reduction strategies with the application of mycorrhizal fungi, which can be done by using seeds encapsulated with mycorrhizal fungal spores.

The other major specific objective is to lower water supply levels and adapt the system for applying beneficial organisms in order

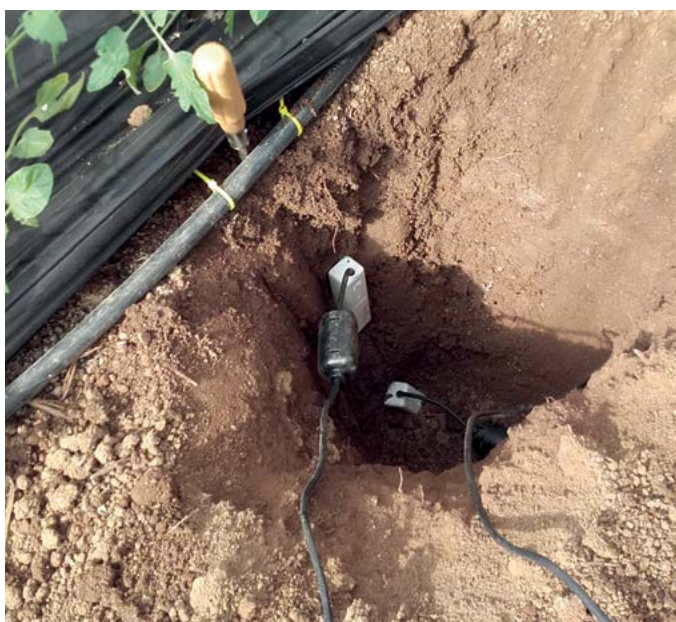
to maintain high levels of productivity and quality. The effectiveness of applying deficit irrigation in combination with the mycorrhization of plants on tomato plantations in both experimental soil plots and sack farming with substrate was ascertained. The project also attempted to optimise irrigation by monitoring the water content in the soil by means of moisture sensors, and applying mycorrhizal fungi. Various systems for introducing and monitoring natural enemies of the pests present in the crop were also tested to see if this natural system provides good results.

02. Results and conclusions

Encapsulating seeds with beneficial organisms appears to be a practical system for making savings on water, due to the protection the capsule provides for the microorganisms. The results indicate that encapsulating seeds with inoculants containing mycorrhizal fungus spores allows the mycorrhization of the plants, and once set up will be an alternative for plant mycorrhization in the early stages of growth.

The results obtained in soil-based tomato farms show that applying a low-quantity irrigation regime in mycorrhizal plants is an alternative to consider in order to maintain tomato production. This combination would allow reductions in the amount of water while improving the microbiological quality of the crop soil. However, this is not the case with sack farming where water productivity in deficit irrigation is lower.

As for the natural enemies of pests, the general conclusion to be drawn is that more abundant irrigation seems to attract adult *M. pygmaeus*, as well as the presence of mycorrhizae. However, it seems that *Nesidiocoris tenuis*, which is native to warmer and drier areas, is favoured by deficit irrigation and the absence of mycorrhizae.



Sustainable innovations for the development of cloth sacks for applications in ornamental horticulture and gardening. Selection of substrates and species

Leader:

Corma, SCCL

Other non-recipient members:

Polytechnic University of Catalonia (UPC), Catalan Federation of Agricultural Cooperatives (FCAC)

01. Rationale

Many of the textile bags used for the cultivation and planting of ornamental plants are made of non-organic materials that generate a great deal of non-reusable waste. This project aims to find innovative solutions in this area, taking into account factors such as the material used, the structures of the fabrics, the design of the products and the various manufacturing processes. It is based on the aim of adopting a philosophy based on the circular economy, and using by-products from the agricultural activities of other Catalan cooperatives as its raw material.

In order to achieve these objectives, it was necessary to classify the new fibres obtained, to study how they could be used to make bags, and to assess their performance in the nursery and in the field, while taking into account the various species of commercial ornamental plants. The method used is based on obtaining fibres from the by-product of corn husks, which are subsequently the main items used to manufacture the new bags. These fibres have properties that make them suitable for use in textile applications, with characteristics similar to those of other natural fibres.

02. Results and conclusions

After a thorough analysis of the characteristics of corn fibres, the products developed with this fabric were as follows:

- Planting bags with a composition of 67% corn fibre and 33% cotton, with the following specifications: grammage ~330 g/m²; thickness ~2.6 mm; tensile strength ~27 N; elongation ~60%.
- Non-woven fabrics for potential application in turf. Its composition is 100% corn fibres, and its specifications are: grammage ~1,100 g/m²; thickness ~8 mm; tensile strength ~35 N; elongation ~25%. These properties are similar to those of commercial nonwoven coconut fibre.

It was also possible to determine how obtaining agrotextiles made from corn husk fibres contributes to the recovery this by-product,

which has been shown to have very high levels of biodegradability.

As a biodegradable product made from an agricultural by-product, these non-woven fabrics contribute to creating a circular economy. They also have the advantage of being a local product produced from an agricultural residue that currently has no market value. The resulting non-woven fabrics can potentially be applied as agrotexiles for landscaping uses requiring rapid biodegradability.

A new bag design was produced, with three channels and a shut-off valve to facilitate filling. This bag can be made with thread stitching, and its design enables easy modification of both sizes and fabric material. The bag filling machinery enables very simple and low-maintenance handling. The proposed bag-machine system allows the prepared bags to be stored and filled on site without adding any closing mechanisms.



MACMHER: alternative methods to control weeds in organic vineyards

Leader:

Codorníu, SA

Other recipient members:

Don Jesús, SA, Raimat Plant Defence Group

Other non-recipient members:

University of Lleida (UDL)

Coordinator:

FEMAC cluster

01. Rationale

Weed management in vineyard lanes can be carried out efficiently and in a way that is suitable for organic production thanks to soil tillage. However, it is much more difficult to remove vegetation growing under the crop line due to the risk of damaging the vines. It is in this area that the main processes of competition for water and nutrients take place and in some cases, and depending on the type of weed, removing them can be costly and ineffective.

The use of specific under-vine weeders has enabled progress to be made in weed control, Those equipped with a hydraulic spring enable the soil under the vines to be tilled and weeds removed, but the action of the under-vine weeder must be stronger, which entails a risk of damage to the vines. At the same time, the ability to remove weeds under the vines cannot be fully guaranteed as it depends on the floristic composition, architecture and plant life structure of the species to be removed.

One of the possible alternatives to using under-vine weeders, particularly given the proliferating infestations of new, fast-growing species, is to use organic mulches made up of a variety of plant materials. Organic mulch generally inhibits the growth of weeds thanks to both its physical effects (light interception and temperature) and its chemical effects (the possible release of allelopathic substances).

The aim of the MACMHER project was to monitor the weed species that develop below the vine cultivation line, and particularly the species *Conyza bonariensis*, and to assess the use of mulchings and new bioherbicides, taking into account their possible inhibitory effects on the vigour and production of the vineyard and their economic viability.

02. Results and conclusions

Studies have shown that planting an adequate thickness of pine bark and chips under rows of vines is a suitable mulching technique, as it prevents the presence of weeds, and especially *Conyza bonariensis*. The possible spreading of straw on pine mulching, dispensed by the chipper in the vine rows, further guarantees stopping proliferation of under-vine weeds. A pine mulch about 10 cm thick and about 80 cm wide ensures a minimum persistence of two years, which helps to maintain the physical effect on the soil and prevents weeds from appearing.

On commercial plots, an appropriate mechanised pine mulching installation is necessary to obtain the thickness and deposition necessary to obtain the desired effect.

During the summer season, pine mulch ensures lower weed cover levels than under-vine weeder. The mixture of pine and compost is not suitable as mulch, as it favours a greater presence of grass. However, the mixture of humic acid and fulvic acid was the most effective treatment in controlling *C. bonariensis*, and reached values even higher than 90% in early stages of weed development (between 2 and 5 leaves). In more advanced stages, these acids cause necrosis in inflorescences and flower heads. The mixture of pelargonic acid and potassium metabisulphite is less effective and depending on the stage of development of *C. bonariensis*, its levels of effectiveness range from 70% to 90%.

Finally, this project established that the herbicidal efficacy of all the substances used is heavily influenced by the weeds' stage of development and density, and as such this factor must be taken into account.



10

OPTIVINYA: grape harvest ripening and quantity control optimisation

Leader:

Masia Vallformosa, SL

Other recipient members:

Juvé & Camps, SA, Celler Josep Piñol, SA

Other non-recipient members:

INCAVI, IRTA

Coordinator:

INNOVI Association of Innovative Companies

01. Rationale

The wine-producing sector in Catalonia has a very significant economic impact, but the quality of its product is heavily determined by the characteristics of the growing areas. This project studied how the use of new technologies provides an exhaustive assessment of the state of agricultural plots where grapes are grown. This tool can be very useful for large associations of wine producers, such as cooperatives, Plant Protection Associations, Designations of Origin, etc.

To this end, the project was based on determining the usefulness of high-resolution remote sensing using satellite image time



series and one-off drone images to determine the vigour of the plants and correlate it to a number of variables in order to predict the quantity of harvest and its classification in terms of quality. Apart from capturing data from aerial systems to calculate the vegetation index, one of the other objectives of the project is therefore to undertake intensive field work to analyse grape yield and quality parameters from the end of the turning until the harvest. The relationship between these parameters makes it possible to generate algorithms that provide the basis for establishing advanced predictions of optimum yields and harvest dates according to the speed the grapes ripen, as one of the variables that affect ripening is the state of the plant cover.

It should be noted that in the Penedès area, where the study was carried out, vines are grown under dry farming conditions, which makes monitoring and predicting the parameters of crop growth and grape ripening a difficult task.

02. Results and conclusions

The use of satellite technology, which has been provided by new systems with high frequency and high resolution, has identified differences in plant vigour that have been directly related to the most important production parameters. It has also led to the conclusion that the amount of plant mass available to the plant is one of the factors that determines the potential production of the vine. This remote sensing system can monitor and quantify these factors by means of the area defined by the time series in the Normalized Differential Vegetation Index (NDVI). The effectiveness of the information provided by the satellite has been fully verified.

Although more abundant samples for the field work would be desirable, the project established a sound correlation between vigour parameters and the percentage growth of the fruit from turning to harvest, which makes large-scale production prediction more feasible, encompassing many plots at the same time, reducing sampling in the field and achieving similar levels of precision. The designed models had a good response despite the low number of starting samples, with levels of accuracy of up to 63% (up to 80% if field sampling is introduced 15 to 20 days before harvest).

As for the economic viability of this system, and taking into account that the information obtained from satellite and environmental data has a maximum cost of 10 €/ha per year, price was not a barrier to entry. Thanks to the tools and protocols described in this project, monitoring large, scattered and usually small cultivation areas such as those often found in Catalonia is feasible, as it would otherwise be very difficult to have the human resources for continuous monitoring. If the prediction accuracy rates observed in the combined method of remote sensing and field sampling could be robustly and reliably established, this working protocol would significantly reduce the number and hours of sampling and analysis in the laboratory.

11

Reduction of cracking in the Fuji apple variety

Leader:

Fructícola Empordà, SL

Other recipient members:

Baguda Fruits, SL, Fruits Sant Pere, SL

Other non-recipient members:

Mas Badia Foundation

Coordinator:

Fructícola Empordà, SL

01. Rationale

Thanks to its organoleptic quality, the Fuji apple is one of the varieties most sought after and accepted by consumers. Despite the agronomic difficulties with this variety, Fuji apple cultivation provides a good economic return if minimum yields are achieved. However, for this reason, it is important to avoid the appearance of defects in the product that increase the percentage of unmarketable fruit. One of these defects is cracking of the fruit, which occurs shortly before harvest and can affect areas including the peduncle, the calyx and the edge of the apple. These cracks can lead to a cracking of the pulp in just a few hours, which often causes the fruit to rot.

Cracking is a problem that normally affects between 10% and 20% of the production, although it can affect up to 50% of the harvest in some crops. There are numerous causes that trigger this condition, although there is one that is always present: rain or high relative humidity a few days before the fruit harvest.

This Operational Group has proposed various solutions that could reduce cracking during the production of Fuji apples in order to address this problem, which creates significant economic losses for growers. The initiative has been based on the development of a harvest management protocol that minimises the likelihood of cracking, while maintaining the potential quality of this variety.

The project involves an analysis of the various systems that can prevent the occurrence of this physiological disorder in order to determine which is the most effective. Some of the methods that have been applied include pre-harvest treatment with Harvista™, various nitrogen fertilisation strategies and the use of rain nets. The use of approved bio-regulators has also been tested, and the impact of two types of irrigation – one drip irrigation and one micro-sprinkler system above the trees – has been assessed.

02. Results and conclusions

The trials showed that the Harvista™ treatment did not offer good results for limiting cracking, as the application levels were probably too high in starches as a result of inclement weather. However, if the treatment is carried out before the fruit ripens, at starch levels of 2-4, it is likely to be more effective.

No differences were found between the different times of application of nitrogen fertilisation, which was applied during the spring both before and after harvest. The trend in the results showed that apples with suspended fertilisation had less cracking and more colour. The different foliar treatments tested also showed no effectiveness for limiting cracking. A strategy was tested with ANA, with GA4+7+BA, with calcium chloride, the combination of the three, with GA4+7, with PARKA® and the Stilo® Hydro Record® biostimulant. As for irrigation systems, there are no clear differences between conventional micro-sprinkler irrigation and drip irrigation.

On the other hand, anti-rain nets proved to be a good alternative for maintaining the quality of the apples' skin, as they significantly reduce cracking despite a slight decline in the percentage of coloured surface. More experience is needed to test materials and installation systems that provide a good economic balance on fruit farms in terms of both fruit quality and return on investment.



12

Use of anti-rain nets to reduce the application of fungicides to control apple scab disease

Leader:

Girona Fruits, SCCL

Other recipient members:

CanMasFructicultors,SL, ExplotacionsAgrícolaBruguera,SL

Other non-recipient members:

Mas Badia Foundation

Coordinator:

Girona Fruits, SCCL

01. Rationale

Apple scab is the most common disease in apple production in most regions of Catalonia. It is caused by the fungus *Venturia inaequalis* and its anamorph *Spillocaea pomi*. The disease appears early in the winter, and comes from spores projected from the inoculum reservoir present in leaves on the ground that were affected during the previous year. The meteorological factor that subsequently triggers the release of spores from the primary inoculum is rain, which with moisture provides the conditions for the fungi to germinate and infect green tissues. Starting with the first spots, new spores appear that spread the disease, affecting new leaves and fruits.

Most currently produced apple varieties are susceptible to the fungus. The disease is controlled by applying fungicides to prevent primary infections from thriving, but 10-20 treatments are often required during the period of greatest sensitivity to annual weather conditions. However, the current legislative framework governing agricultural production in the European Union regarding the use of plant protection products, the foreseeable new guidelines of the CAP and pressure from public opinion are leading to a shift towards the reduction of pesticides in apple production, including fungicides.

This project was carried out in order to develop a model for controlling apple scab that minimises the application of fungicides during the apple production process. The two systems proposed were the installation of anti-rain netting and the use of inoculum removal techniques for *Venturia inaequalis*.

02. Results and conclusions

The results of the installation of anti-rain nets show that fungicide treatments against apple scab can be eliminated or reduced in

varieties with similar levels of susceptibility to Fuji, even in years when the disease has high incidence levels. In 2020, when there was a high incidence of apple scab, 20 fungicides were used in the standard parts and only 0-6 in the areas covered by the anti-rain nets, with similar results. For varieties that are more sensitive than Fuji, the number of fungicides required can also probably be reduced under nets in a similar way.

The nets modify environmental conditions in the orchard. With their protection, rain does not fall on trees directly, the duration of leaf wetness and light are shorter, and the maximum daily temperature increases during the spring. Some treatments to control other diseases such as powdery mildew and pests such as red spider mite may have more positive effects under nets. The production of the trees and the size of the fruit is not affected by this coverage, but the red colouring of the apple is reduced. Other studies show a positive effect of nets in reducing cracking and russetting in fruits sensitive to disease.

The application of inoculum reduction measures for *Venturia inaequalis* has been found to complement standard fungicide treatments for improving the control of primary mottling infections. This is particularly true in years of with high levels of incidence of the disease, when the disease is more apparent on the fruit than on the leaves. The most effective methods were the mechanical collection of leaves and burial by soil moving. The application of *Trichoderma* did not improve the result compared to conventional fungicide treatment.



13

Development of a technology for the monitoring of all the liquid manure from a farm on an annual basis in order to determine its nutrient content (N, P, K) using NIR (near-infrared) technology and its volume using sensors.

Leader:

Agrària Plana de Vic i Secció de Crèdit, SCCL

Other non-recipient members:

Grup Solucions Manresa, SLPU, Balmes University Foundation

01. Rationale

In order to be able to determine the amount of nutrients applied to the soil per livestock farm in Catalonia with greater accuracy, this project aims to develop and validate the operation of a tool able to obtain a more accurate measurement of the nitrogen, phosphorus and potassium generated on each farm. This technology, called near infrared (NIR) and linked to the current GPS tracking of tanks, would enable full monitoring and quantification of the distribution of the application of nutrients from livestock manure all over Catalonia.

The project aims to implement and validate the use of IR sensors and optical flowmeters, as they are reliable and accurate tools for measuring the amount of nutrients generated on livestock farms, and animal slurry in particular. It also aims to develop an application compatible with the current platform used by the Generalitat de Catalunya which incorporates the monitoring of nutrients generated and applied to the soil all over Catalonia.

02. Results and conclusions

The results obtained show that, in addition to providing results for total solids and ammonium that cannot be obtained from the conductivity lines of the Ministry of Climate Action, Food and Rural Agenda (DACC), NIR provides more accurate data on the exact levels of nitrogen, phosphorus and potassium. Although the relative error in most readings is between 10 and 20%, it is over 20% in the case of the conductivity line. The parameter with the poorest reading is phosphorus. However, this cannot be correlated to electrical conductivity, and as such the Ministry provides default values based on type of slurry. This is why the error is much higher for Ministry figures. The NIRS is capable of determining the nutrient content of slurry with a mean relative

error of less than 20%, except in the case of P_2O_5 , where the mean relative error is approximately 25%.

In order to convey the slurry parameters to the DACC in real time, the decision was taken to work with the company Triskel Telecom, as its GPS was installed in the tank used for the sampling. The company has a platform for undertaking this management, and has developed the hardware and software necessary to convey the data from the slurry measuring station. When the NIR measuring station software is combined with the monitoring and data transmission system devised by Triskel Telecom, it is possible to track the amount of nutrients generated by each farm and their point of application in the soil in real time.

The results obtained are conclusive in determining that the NIRS is technically feasible, as it provides good readings for nutrients while improving the accuracy of the conductivity meter, which is the technology currently used by tankers transporting slurry. It becomes economically viable when 100 ha of land are fertilised, and has a minimum return on investment of 12 years. However, until there is stricter legislation on the accuracy of nutrient application to soil, the conductivity meter is still the most affordable option, as its investment cost may be around 25% of the cost of NIR.



GOTA: Guide for the Optimisation of the Use and Treatment of Drinking Water for Fattening Calves

Leader:

Corporación Alimentaria de Guissona, SA

Other recipient members:

Nanta, SA, Soluciones Integrales para la Nutrición Animal, SL

Other non-recipient members:

Setna Nutrición SAU, ASOPROVAC, Catalan Association of Compound Food Manufacturers (ASFAC), IRTA

Coordinator:

Alcarràs Cattle Entrepreneurs Association (AEBA)

01. Rationale

Water is a key issue for the future of human and animal activity, as it will become an increasingly limited resource, and its quality is expected to decline in the coming years. Estimates suggest that there will be a significant increase in demand for drinking water as a result of growth in population levels and agricultural production, and the estimated change in rainfall patterns due to



climate change will make this task much more difficult. Water quality is deteriorating, mainly as a result of nitrate contamination and poor microbiological loads.

The ultimate aim of the GOTA project, is to prepare a Guide for the Optimisation of the Use and Treatment of Drinking Water for Fattening Calves. Its Catalan acronym, GOTA, translates as drop, symbolising the value of a drop of water in today's world. The intensive cattle fattening sector is aware that despite being the most important nutrient for cattle and the major constraint on feed consumption, water treatment has not been prioritised to date.

The initiative aims to obtain exhaustive knowledge of water consumption in the different stages of fattening in order to be able to draw up consumption curves according to age and time of year, which will enable the supply to be adjusted to the demand shown, and provide data on the water footprint. It also aims to optimise consumption by assessing the type and number of drinking troughs, and determining the optimal quality, especially in terms of nitrate composition. Finally, it aims to study the drinking water treatments that are most effective on consumption.

02. Results and conclusions

The consumption curves showed that the water footprint of calves reared in Catalonia is smaller than the estimated international average. With this information, it was possible to reduce a practical guide for the optimisation of water use and treatment in the sector.

Having water troughs two per pen does not appear to increase water consumption or improve animal growth rates. It should be noted, however, that the troughs were cleaned weekly. If the water consumption is carried out with a dipper, there is a reduction in water consumption levels, especially in the hottest periods of the year. It will be necessary to determine whether the difference in consumption affects the growth of the livestock.

In the purification/sanitisation treatment, the physical-chemical and microbiological water quality parameters were changed for the better thanks to the use of chlorination or pH acidification, especially when the two treatments were combined. The sampling location is crucial in the interpretation of the data, but there have been no negative effects on consumption of water, feed or straw, or on calf health to date. Acidification of pH only reduced fibre digestibility at the beginning of the study; Meanwhile, chlorination slightly increased the digestibility of starches.

Finally, calves are able to detect high levels of nitrates and reduce their water consumption to protect themselves from possible poisoning. Further tests are needed to see if this has any consequences for production data, but so far it does not seem to affect the animals' health.

15

Implementation of a new natural environmentally friendly product to prevent Acariasis in farm-reared snails

Leader:

Cargols de Cal Jep, SL

Other recipient members:

Pinallet, SA

Other non-recipient members:

Interprofessional Organisation of Snail Farmers (INTERHÉLIX), Autonomous University of Barcelona (UAB)

Coordinator:

Autonomous University of Barcelona (UAB)

01. Rationale

The presence of mites on snail farms is a problem that has a significant effect on the animals, and can lead to disease and even death. The mite *Riccardoella limacum*, which affects only snails, is more prevalent on farms than in the wild. This is due to the specific conditions of humidity and high temperatures on these farms, and can lead to reduced yields.

This innovative project aims to provide a solution to this problem and market a new natural product to prevent acariasis or reduce it as much as possible. It is a new product based on natural additives that aims to ensure its efficacy against mites that affect farmed snails in a pilot test. It also aims to increase the efficiency of the feed used to feed the animals, which will enhance their nutrition in a natural way and improve the competitiveness and sustainability of snail farms in today's market.

02. Results and conclusions

The final results of the trials constitute a breakthrough at all levels, as both the productivity and sustainability of the snail farms significantly improved. It was therefore possible to ensure the long-term stability of the farms, and the sanitary quality of the final product. The use of pharmaceuticals and chemicals is avoided during the snail rearing process, which also saves a great deal of water, as the farms do not need to be cleaned to the same extent.

The most effective dosage mixture was determined to be 0.3% oxalic acid plus 0.04% thymol in a kilo of feed. This leads to a reduction in mortality at all stages in the life of the snail. The presence of mites during the maternity and breeding period fell to almost zero. The absence of mites improves the animals' health,

and their immune system becomes more resistant to infectious diseases. Productivity increases significantly with lower mortality levels and higher egg-laying levels. We still found some mites during the fattening phase, but their numbers were greatly reduced.

The limited presence of mites means that the feed with additives is more effective. When mite presence is very high, the snails are weakened to the extent that they do not consume the feed and applying treatment with additives is very difficult. In addition, the sustainability of the farms has been demonstrated by the fact that with this treatment, water is reused to produce more snails and their water consumption is reduced.



New environmental and nutritional model at broiler chicken farms to reduce non-infectious lesions

Leader:

Agrobaiona, SL

Other recipient members:

Corporació Alimentària de Guissona, SA

Other non-recipient members:

IRTA

Coordinator:

Agrobaiona, SL



01. Rationale

In the broiler industry, animal welfare and quality of the end product are two aspects that are closely linked and are in increasing demand from both the end consumer and the industry. The current legislation on broiler protection and welfare states that contact dermatitis is one of the main criteria in the assessment of the rate of injuries. This pathology often leads to the appearance of pododermatitis, tarsal burns and scabs on the bird's chest.

Factors such as litter quality and care of nutrition and digestive health can prevent pododermatitis. Most injuries detected occur for two main reasons. The first is the moisture content of the litter, which largely depends on the materials used in its manufacture, and the second is the amount of ammonia released from the nitrogen in the chickens' stools.

In order to reduce the rates of pododermatitis in the agricultural sector, the broiler farm AGROBAIONA, the agro-industrial company Corporación Agroalimentaria de Guissona and IRTA carried out a joint study which aims to achieve the following objectives:

- Establish the most suitable litter materials for chickens for optimal absorption and dryness characteristics.
- Determine the most appropriate litter management system, taking into account factors including turning, sanitisation and the use of nitrogen reducers.
- Evaluate various diets that provide good intestinal health for poultry.

02. Results and conclusions

After all the tests carried out, the initiative has drawn a number of conclusions that will help to reduce the occurrence of problems related to pododermatitis in the future. Firstly, a reduction of between 1.2% and 1.5% was observed, depending on the broilers' stage of growth, with the inclusion of crude protein in their nutritional diet, leading to a 7% reduction in nitrogen secretion from their stools. This considerably reduces the incidence of pododermatitis while reducing the occurrence of soiling of the crest at the same time. The crude protein is supplemented with synthetic amino acids, and the resulting diet was also observed to improve productive development during the first half of the poultry fattening phase.

As for bedding, chopped straw was found to be the optimal material for reducing the occurrence of pododermatitis and soiling in quality cuts at the slaughterhouse. The study therefore showed that combining this type of litter with a diet low in crude protein is an effective tool for improving animal welfare, minimising environmental impact and increasing broilers' productivity.

17

New optimisation strategies in pig production based on the use of liquid feeding and the incorporation of computer vision and neural network tools for weight control and monitoring

Leader:

Catalana de Pinsos, SA

Other recipient members:

Matadero Frigorífico del Cardoner, SA, Setna Nutrición, SAU

Other non-recipient members:

Autonomous University of Barcelona (UAB)

Coordinator:

Garage Lab

01. Rationale

Pig farming is very important within the Catalan livestock sector. According to data from the Statistical Institute of Catalonia, it is second place in terms of the number of head, with some 6,500,000 animals, only surpassed by the 43,000,000 in the poultry sector. A large proportion of the pigs are fattening pigs that are reared for about 4 months to a final weight of 110-120 kg before being slaughtered at the slaughterhouse.

It is essential to make pig production uniform in order to increase the competitiveness of the pig farming sector. For this reason, this project began a process to improve the yield of production lines that will lead to a higher quality end product, according to parameters related to the Daily Weight Gain (DWG) and Feed Conversion Ratio (FCR). Both values depend on many factors, including genetics, the quality and quantity of feed and water consumed, and rearing conditions.

This project studied various aspects of pig fattening, with the installation of a set of sensors both on the farm and in the slaughterhouse that provide real-time data. State-of-the-art technologies in the field of artificial intelligence have also been introduced, including computer vision and new deep learning computing methodologies.

A very important factor in the pig fattening process is the pig's feed. Pigs have traditionally been fed with feed, but experiments are now being carried out with liquid feed, which is much easier for the animals to digest. For this reason, we wanted to test the effects of this type of feeding, which should enable the growth and fattening curve of the animals to be monitored, and ensure that production is regular and uniform.

02. Results and conclusions

The experiments, which were carried out on a set of 25 animals, showed that implementing a system to estimate the weight of a pig by its volume is logical and facilitates work. The conclusion was that a more comprehensive dataset should be generated to increase the accuracy of the model, and so a circuit was set up to obtain weight and volume data more frequently and automatically using 3D cameras.

On the farm, it was possible to implement a feeding system for the pigs with fermented feed. This type of feeding was found to have some advantages, such as improving the animals' daily growth and their digestion by reducing the frequency and severity of diarrhoea. Liquid feed was also found to be less wasteful than the feed normally used.

The *dataset* of images captured at Mafrika's facilities enabled optimal monitoring of the animals. The system has some errors when a pig hides its head for too long or moves very quickly. The system that estimates the level of soiling works quite well, but if a mechanism to monitor the lighting of the corridor through which the pigs have to pass to go to the stalls were introduced, it could be improved further.



Selection of feed for gilt pigs to improve the lipid profile of high-quality cured sausages

Leader:

Grup Gepork, SA

Other recipient members:

Splendid Foods, SAU

Other non-recipient members:

Balmes University Foundation

Coordinator:

INNOVACC

01. Rationale

Cured sausages are one of the fattiest foods in Spanish consumers' diet. For this reason, the sausage meat industry is expected to focus on producing foods that are healthier for the consumer, and have a better nutritional profile. Varying the composition of some raw materials through animal genetic selection and/or feeding could be a useful way of obtain healthier foods.

Achieving this objective without diminishing the food's sensory quality is an added challenge, as its acceptance is highly dependent on this factor and could determine the subsequent success of the product in the market. This nutritional improvement must be achieved by looking at the following parameters:

- Modification of animal feeding in the lipid profile of the meat.
- Assess the viability of using pork with a better lipid profile as the raw material for the sausages being studied.
- Assess the nutritional and sensory properties of the sausages.
- Determine the colour and texture profile of the sausages.

It is also necessary to ensure sustainability and a reduced environmental impact. For this reason, the project also focused on evaluating 3 types of feed used on fattening farms, to see which is the most environmentally friendly. It is also necessary to identify the critical points in the value chain in order to optimise the consumption of resources and energy.

02. Results and conclusions

In conclusion, the animal's diet and its fattening season have a clear impact on the chemical and nutritional properties of fresh meat, which is especially notable in the fatty acid profile. If a special diet with a high level of unsaturated fatty acids is applied, the

amount of unsaturated fatty acids in meat increases significantly and the amount of saturated fatty acids declines. These changes in the composition of the meat are not apparent in the cured product, which shows that further studies involving modifications in the animal's diet will have to be carried out in the long term.

Although chemical changes in cured sausage are not significant, there are sensory changes that show how other elements not analysed in this study, such as volatile aroma compounds, may be modified during fattening.

Feed production is the phase in the pork production value chain with the most environmental impacts. Improving feed formulations from an environmental point of view, and not only from a nutritional point of view as has often been the case so far, has been shown to be a key factor if the sustainability of the pig farming sector is to be improved. The new feed compositions for the later stages of fattening developed during this project were shown to have a markedly better environmental profile than the conventional formulation. The total environmental impacts per kilo of meat were therefore significantly reduced.

Finally, the project showed that with proper land management on farms and extensive accommodation units, the environmental quality of the landscape can be significantly improved, increasing the presence of pollinators and enhancing the biodiversity of agro-industrial ecosystems.



19

Bovine livestock waste recovery and reuse

Leader:

La Fageda Foundation

Other non-recipient members:

Balmes University Foundation

01. Rationale

The number of livestock in Catalonia has increased considerably in recent years, while the area of useful agricultural land has significantly declined. This proliferation of areas with high agricultural density means it is increasingly necessary to develop and implement technologies for recovery of all surplus livestock manure that cannot be safely used as fertiliser.

An option for the use of this excrement is the application of the biodrying process for energy recovery. This innovative process applied in the livestock farming sector would provide a biofuel (with LCV > 2,500-3,500 kcal/kg) that could be used in conventional biomass boilers. Biodrying is similar to composting, but its final objective is different; while the latter seeks to maximise the stability of organic waste by mineralising organic carbon, biodrying aims to use the metabolic heat created by biological activity to remove water from the waste matrix in the shortest possible time. Carbon degradation is thereby minimised, and this means that most of the calorific value of the matrix is retained.

The main objective of the project is the development and optimisation of the cattle manure biodrying process, with the aim of

obtaining a biofuel that is suitable for use in conventional biomass boilers.

02. Results and conclusions

The results obtained show that weather conditions affect the biodrying process. For this reason it was decided to cover the pile on rainy days and turn the mixture over daily. If the pile is covered, rain does not cause an increase in the humidity of the mixture, although there may be variations in some cases due to the high humidity levels of the environment. A material with 50% moisture content was obtained after 50 days of operation, which was not expected, as the levels should be below 40%.

The LHV value observed with the mixture at 50% was 5.6 MJ/kg, but after forcing moisture down to 40%, the LHV values increased to over 7.2 MJ/kg. If the material can be dried to 40% moisture, the combustion process would therefore be worthwhile.

At the same time, and given that the results were not as satisfactory as expected, the decision was taken to test a solar drying system in a greenhouse. These tests provided lower moisture values in a much shorter time, with a 60-70% reduction in moisture between 7 and 14 days. The return on investment period for solar drying was found to be around 5 years. In contrast, the return on investment period for biodrying is around 11 years for a composting plant, and 25 years if the plant has to be built from scratch.

A possible improvement for optimising the livestock waste management system in La Fageda involving a biodrying stage would be to install a solar power plant to generate electricity for consumption by the aeration pumps. The use of renewable energy would have a significant positive impact, but the economic feasibility of implementing these process improvements has yet to be fully analysed.



Capture and reuse of CO₂ at a pig slaughterhouse: from the WWTP to the stunning process

Leader:

Escorxadador Comarcal del Moianès, SA

Other non-recipient members:

University of Girona (UdG), INNOVACC

01. Rationale

WWTPs located in pig slaughterhouses produce a lot of gases that are often released into the air and are harmful to the environment. To avoid this, this project attempted to develop a system for capturing the gases, which in turn allows the CO₂ to be separated for subsequent reuse in the stunning of pigs before slaughter. This reduces the greenhouse gas emissions produced in the slaughterhouse treatment plant, and reduces the volume of CO₂ that the slaughterhouse would have to purchase for the stunning phase. These advantages could enable the resulting technology to be extended to the entire slaughterhouse sector and other types of industries with WWTP.

The project, which aims to generate and publicise all its results as it is carried out, is based on the following actions:

- Development of a pilot system to capture the gases emitted in the reactor of the slaughterhouse's WWTP. This also makes it possible to determine the composition of the gases captured.
- Testing of various techniques to recover the CO₂ in the gases emitted at the WWTP and to determine which is the most appropriate. This would allow the maximum recoverable CO₂ production to be determined and its usefulness for stunning pigs to be assessed.
- Experimenting with the stunning of pigs with CO₂ recovered from the WWTP, to rule out possible health incompatibilities of the gas with the animals and to analyse the quality of the meat obtained to see if there are possible differences compared to the meat obtained with conventional stunning.

02. Results and conclusions

The results show that the average concentration of CO₂ obtained from samples of the gases released from WWTP reactors is high enough to be self-sufficient in the supply of CO₂ and to ensure the pigs are stunned. This leads to significant financial savings when purchasing this gas, and a reduction in the greenhouse gas emissions produced in the slaughterhouse treatment plant. Currently, production and purchase costs of food grade CO₂ are low, which means it is not an expensive gas and is readily available as

a chemical industry by-product. However, consideration needs to be given to a future scenario in which greenhouse gas emissions are an additional cost for companies and where sustainability and reducing environmental impacts are rewarded.

Current technologies enable optimal capture and separation of CO₂ from WWTP gases, especially with the use of the monoethanolamine (MEA) aqueous chemical absorption methodology. However, the current costs of capture/separation are still quite high. Moreover, no negative effects on animal welfare or meat quality due to the use of CO₂ recovered from the WWTP were observed.

On an experimental scale, it was possible to capture the gases from the WWTP, but extrapolating this to the entire reactor would entail changing their design from open to closed. This would imply excess costs in construction and the loss of the advantages of open reactors in terms of maintenance.



EMBOT-ITS: use of advanced technology and big data management to optimise sausage drying rooms

Leader:

Splendid Foods, SAU

Other recipient members:

Patel, SAU

Other non-recipient members:

Eurecat

Coordinator:

INNOVACC

01. Rationale

The companies Splendid Foods and Patel carried out a project aimed at increasing the sustainability, competitiveness and optimisation of the production processes in the sausage sector in order to foster its internationalisation process.

In the project, resource use and manufacturing conditions associated with cured sausage production were assessed, focusing on drying, but including prior processes that may have an effect on them. For this reason, the production process was analysed in order to identify elements such as flows, resources used, properties of the raw materials and the environmental conditions in each of the phases.

The aim of the project is to improve efficiency in the sausage curing process through advanced data analysis and intelligent systems to aid decision-making. The specific aim is to study, monitor, model and apply control strategies that optimise the drying of sausages, which will reduce curing times and standardise them so that product losses are uniform. It is also essential to ensure that the entire process does not affect the quality of the sausages produced.

02. Results and conclusions

By studying the data collected during the monitoring of up to 22 sausage drying processes during the course of the project, it was possible to determine the precise behaviour of the dryer studied, which showed that the behaviour of temperatures and humidity varies according to height, which means it is necessary to define the optimum drying strategies in each situation. Significant improvements were achieved in the production process, which will

reduce the duration of the whole process from the current 13-14 days to 11-12 days. There is also a 20% increase in the dryer's rotation capacity, which enables a commensurate increase in productivity. This optimisation contributes to increased energy savings for producers.

The behaviour of the products while they are in the dryer was also improved, which increases their uniformity in the flora in terms of their height, without losing the desired water activity and pH values. Finally, quality levels were maintained even when the density of the dryers was increased from 40,000 to 60,000 sausages.

Thanks to the collaboration between the project partners, a very precise monitoring system for the behaviour of dryers was implemented, enabling them to be integrated into the production systems. This made it possible to generate a data record that allows us to continue working on the improvement of the production processes. The technology developed was improved during the course of the project, and became a system that issues alerts when there are problems in sensors so that they can be solved. It also made it possible to avoid large gaps in the data, where both spatial and categorical identification is performed almost automatically, and the information is post-processed before being collected by the API (Application Programming Interface), which ensures that the best quality data are provided.

The optimisation resulting from this project has increased the company's profits. This creates an opportunity for the entire meat processing sector to improve its production process and to raise its profile both nationally and internationally.



FML: minimisation of unwanted malolactic fermentation in sparkling wine

Leader:

Castillo de Perelada, SA

Other recipient members:

Masia Vallformosa, SL, Codorníu, SA

Other non-recipient members:

Rovira i Virgili University Foundation

Coordinator:

INNOVI Association of Innovative Companies

01. Rationale

Malolactic fermentation or MLF is the conversion of L-malic acid to L-lactic acid by lactic acid bacteria such as *Oenococcus oeni*. In many wines, and especially red wines, this process takes place either spontaneously or by inoculating starter cultures that help to reduce acidity levels and achieve organoleptic improvements. However, MLF has negative effects when present in low L-malic wines such as cava-type sparkling wines, as it reduces their acidity which is a desirable organoleptic feature. This shortcoming

can lead to wineries being forced to discard their product, with the resulting significant financial losses.

This project aims to prevent undesired malolactic fermentation in sparkling wines, and to investigate what preventive measures could be taken to minimise its occurrence. The effects of chitosan, potentially inhibitory yeasts and fumaric acid were evaluated on the basis of various tests carried out by the wineries participating in the project. Based on these tests, the aim is to establish in a new procedure which sets a new standard for preventing MLF in crop growth and grape ripening parameters.

02. Results and conclusions

The project determined that lactic acid bacteria appear in the first stages of the cava production process. It also enabled the characterisation of various strains isolated from cava, including *Oenococcus oeni*, which were classified according to their tolerance to the inhibitor treatments assessed throughout the project. When strains isolated from cava were compared with strains used as MLF starter cultures in still wines, the isolates were observed to be more resistant to SO₂ and chitosan treatments, but at the same time they were much more sensitive to treatment with fumaric acid.

Fumaric acid was therefore confirmed as the best treatment for preventing MLF both before and after fermentation and during tirage. This treatment has no negative effect on the wine's foamability or its organoleptic characteristics.



Promotion of the cultivation of beans in Catalonia through the innovative canning of the DOP Mongeta del Ganxet (ganxet bean, Protected Designation of Origin – PDO)

Leader:

Conserves Ferrer, SA

Other recipient members:

Cooperativa Agrícola el Progrés-Garbí

Other non-recipient members:

Ganxet Bean PDO Regulatory Council, IRTA

Coordinator:

Miquel Agustí Foundation

01. Rationale

Ganxet beans are a quality legume that is highly regarded by consumers, but they are hardly ever sold in cans. This is because the techniques used in canning, and especially sterilisation, profoundly alter its organoleptic characteristics and make it sensorially more similar to other canned beans, which would be very different if cooked in the traditional way. Since it is difficult to recognise their quality, consumers are not willing to pay a higher price for them. It would therefore be desirable to reduce the heat treatment in order to maintain objective sensory differences between the canned product of an excellent raw material and that of a lower quality material.

With this objective in mind, a project was launched in 2018 aimed at optimising cultivation and heat treatment in order to produce preserved Ganxet beans. The final aim is to achieve a product that is objectively recognisable thanks to its sensory quality, and which respects the characteristics of the Ganxet PDO bean as much as possible when cooked in the traditional way. The companies that form part of the project's Operational Group will thereby be able to break into the canned bean market and take full advantage of the legume's Protected Designation of Origin seal, both locally and internationally.

02. Results and conclusions

Thanks to the project, on the one hand, it has been possible to identify the typical aroma and flavour of Ganxet beans and on the other, to determine the key factors that have to be taken into account in the canning process with heat treatment in an autoclave. These factors make it possible to create an end result

that is as close as possible to the traditionally cooked product.

Studying the different varieties of Ganxet bean showed that when yields are higher, the differences between them are intensified, and that, conversely, they are less so when yields are lower. Furthermore, neither the variety nor the origin of the Ganxet beans has a great deal of influence on the sensory quality of the end product after the preserves have been cooked with the Conserves Ferrer company's usual heat treatment.

Six different protocols for the heat treatment of Ganxet bean preserves were also designed during the project. The study of the physico-chemical and sensory parameters on samples prepared with different varieties and treatments shows that the production of Ganxet bean preserves sterilised with the new protocols provides a better quality product than that obtained with the protocol used to date. The study confirms that the new protocols are less aggressive to the raw material and therefore maintain the quality.

Finally, the project also demonstrated how the use of NIR spectroscopy is an alternative tool for the quality control of the raw material. The tests carried out made it possible to develop a model for predicting the degree of curvature with very high levels of accuracy, while at the same time making it possible to evaluate the dry matter, soluble solids content, colour and antioxidant capacity of preserved Ganxet beans.

The actions carried out in this project provided greater knowledge of the behaviour of the Ganxet bean, in terms of both agronomy and its sensory and culinary aspects. In addition, a new protocol has been developed for the heat treatment of Ganxet bean preserves, which is less aggressive to the raw material.



ELMIRA: pilot project on innovations in post-harvest treatments against weevils in rice

Leader:

Nomen Foods, SL

Other non-recipient members:

Catalan Federation of Agricultural Cooperatives (FCAC),
Autonomous University of Barcelona (UAB)

01. Rationale

The presence of insects after rice harvest has been harvested is a widespread problem that can lead to the loss of a large part of the stock. This project aims to take a major step towards reducing this risk by using a residue-free physical technology based on the industrial application of dielectric heating to eliminate insect pests in cereals and/or other types of grain. This system raises the temperature in a way that attacks the insect larvae that develop inside the grain without affecting the properties of the cereals. Its energy consumption levels are also very moderate, and the prevalence of pesticides in the end product is avoided.

The objectives to be achieved with this project are as follows:

- Validate the breeding systems of the insects of interest (*Sitophilus oryzae*, *Oryzaephilus surinamensis* and *Tribolium confusum*) in order to obtain sufficient eggs, larvae and adults to enable the effectiveness of the treatments to be assessed.
- Assess the degree of infestation of the rice grains in order to be able to define the treatment intensities necessary to ensure the stability of the product.
- Carry out preliminary tests in which the insects are killed using microwaves and construct mathematical models to predict the effect



- of the microwaves on the survival of the three species of interest.
- Conduct insect elimination tests with the radiofrequency pilot prototype, and subsequently determine its effectiveness, including treatment penetration tests.
- Undertake physical, chemical and sensory assessment of the changes that radio frequency treatments may cause in rice.
- Define the technical specifications and requirements that have to be met by the future radio frequency equipment.
- Disseminate the results and prepare proposals for the exploitation of the developed technology and products.

02. Results and conclusions

The results showed that energy densities of around 150 J/g cause a moderate increase in grain temperature and a reduction of about 50% in the vitality of the insects present, while those in the range of 300 J/g eliminate 90% of the insects at any stage of larval development. The disadvantage is that the heat generated cannot be evacuated properly, and this leads to excessive heating of the product.

Samples with higher humidity levels undergo greater heating (the differential in the dielectric coefficient between the grain and the insect is smaller), and this leads to greater changes in the cooking characteristics. The cooking time increases in the high humidity samples, probably because part of the applied energy causes starch gelatinisation. When the higher temperature is not accompanied by increased availability of water, the gelatinisation of the starch does not increase, leading to small cracks that allow water to penetrate more quickly when the product is cooked.

Maximum efficiency is therefore obtained when treatments of moderate intensity (100-200 J/g) are applied to low moisture grains. This solution would allow polished, packaged rice to be treated at the packaging line exit to reduce the risk of insects in egg or larval form developing inside the rice grains. Furthermore, because no artificial or natural pesticides are used, the waste is reduced to zero and energy consumption levels are very low, demonstrating this system's environmental sustainability.



MATSOS: more sustainable plastics for use in the meat industry

Leader:

Embotits Salgot, SA

Other recipient members:

Embotits Monells, SA, Matadero Frigorífico del Cardoner, SA

Other non-recipient members:

IRTA

Coordinator:

INNOVACC

01. Rationale

The European plastics strategy proposes a number of actions to achieve the changes needed to move towards a circular economy that will reduce waste generation and increase the recycling rate and reuse. Ensuring 100% of plastic packaging marketed in 2030 is recyclable, compostable or reusable requires investment in sustainable solutions that involve efficient use of resources, without compromising the shelf life of packaged foods or consumer safety.

The MATSOS project aims to meet this challenge by developing new structures of more sustainable plastic materials for the packaging of fresh, cooked and cured meat products, following EU Regulation 10/2011 on plastic materials and objects intended to come into contact with food. Several objectives have been set in order to improve the sustainability of this packaging. First, it aims to develop new, more sustainable plastic material structures in order to reduce the amount of raw materials (resins) required, reduce post-consumption waste, and facilitating subsequent recyclability.

These materials must then be validated by studying the shelf life of various meat products, which will enable the plastics currently in use to be replaced, and facilitate the appropriate changes towards a resource-efficient circular economy. Finally, there is a need for more sustainable materials which do not compromise the food's shelf life, maintaining quality and safety for the consumer.

02. Results and conclusions

The final results of the project were highly satisfactory, leading to reductions in the amount of raw materials needed to manufacture the new materials in most packaging solutions. Structures have been designed which have reduced the different types of polymers, which facilitates their subsequent recycling, optimising the structures of plastic materials with regard to the functional needs of the various packaged products.

For fresh meat products packaged in modified atmospheres, where gas barrier requirements are not critical and the product has a short shelf life of less than 10 days, the use of mono-materials is a viable sustainable solution, although improvements in appearance and processing factors will still be necessary.

There are sustainable solutions for vacuum-packed sliced cooked meat products based on structures with polymer from the same family that ensure the preservation of this type of product. Reduced thickness at the base does not compromise the shelf life of those packaged in a protective atmosphere. Coating-based barriers applied to flexible materials guarantee preservation of the product, but new oxygen barriers in semi-rigid materials will have to be explored, as the tested alternatives lose their effectiveness over time.

In cured meat products with the presence of fungus and a long shelf life, it is important to adapt the permeability of the sustainable material to the water presence of the product and its susceptibility to oxidation. Solutions using mono-materials have achieved conservation results equivalent to those currently used, although the result has not been the same for the compostable alternatives tested. The companies have been adapting the plastic materials they normally use to more sustainable structures during the course of the project, and some of the packaging solutions developed and validated in the MATSOS project are now in use.



Improvement of the productivity and quality of the oil used for Terra Alta Protected Designation of Origin (PDO) Olive Oil

Leader:

Unió Fruits, SCCL

Other recipient members:

Agrícola de Corbera d'Ebre, SCCL, Unió Fruits, SCCL, Agrícola Sant Isidre de la Fatarella, SCCL, Covilalba, SCCL

Other non-recipient members:

Eurecat

Coordinator:

Terra Alta olive oil PDO Regulatory Board

01. Rationale

Current agronomic practices related to irrigation, fertilisation and harvesting and individualised production methods at oil mills using different extraction conditions do not produce extra virgin oil with the requisite levels of consistency and quality. The innovative work done to increase the proportion of oil considered to be high quality with respect to the entire production of the Terra Alta PDO may constitute a benchmark for other areas as well as a breakthrough in olive oil production methodology.

This project, in which cooperatives located in the Terra Alta Oil PDO region have participated, aims to carry out an experimental design to obtain extra virgin oils with the highest levels of organoleptic and physico-chemical quality, which is more homogeneous and with a quality that is a benchmark in the market. In



order to monitor and optimise a large proportion of all the determining factors affecting this product, this experimental design is based on the following points:

- Perform market research to determine at first hand consumers' preferences in relation to the organoleptic and physico-chemical qualities of extra virgin olive oil.
- Select representative plots of land in the area covered by each cooperative participating in the project that grows olives of the Empeltre and Arbequina varieties. The plots are selected according to rainfed and irrigated systems.
- Analyse the physical and chemical properties of each batch of olives before they enter the mill, and subsequently carry out a study of the most suitable characteristics to improve the quality of the oils. This will be done by taking the different extractive and cleaning variables of the oil into account, and carrying out analyses of the product obtained.

Finally, a protocol of good agronomic and extractive practices will also be drawn up to improve Terra Alta PDO oils.

02. Results and conclusions

The market study determined that the perfect oil is a markedly fruity oil (with values of 6.73 out of 10), sweet (5.56 out of 10), slightly spicy (4.39 out of 10), and slightly bitter (4.01 out of 10). That was the assessment of the participants in the tastings. Mature oil comes closest to the perfect oil. This is oil obtained from olives at a state of ripeness with a maturity index (MI) of 4. However, green oil, obtained from unripe olives with an MI of 2.5, has a fruitiness level that most closely matches the perfect oil.

As for the agronomic and milling protocols to obtain the desired oil, the conclusion was reached that the harvest should begin at the beginning of October, even though this may seem too early, and that the maturity index of the fruit should be around 2.5 if it is to be an Extra Virgin Olive Oil (EVOO). Overripe olive oils are not classified as Extra Virgin either organoleptically or chemically.

The olives should be harvested with an MI of 2.5, and the sieve should have a diameter of 6, as a sieve of 5 increases emulsions and reduces extractability. The threshing time must not exceed one hour, and its temperature must be below 30°C. If it is to be labelled as cold extracted, it must not exceed 27°C during the process.

The oils must also be filtered a week after production. There is nothing to be gained by storing cloudy oils. It is always better to store them clean. Otherwise, it is necessary to be very careful and methodical when transferring them, as everything must be cleaned, especially if the olives are ripe.

Finally, it is essential to use the best available technology that incorporates self-cleaning items to reduce working hours and increase profits.

Obtention of pig fattening standards for Ral d'Avinyó pigs to produce optimal quality pork

Leader:

Matadero Frigorífico de Avinyó, SA

Other recipient members:

Catalana de Embutidos, SA

Other non-recipient members:

IRTA

Coordinator:

INNOVACC

01. Rationale

The Ral d'Avinyó genetic line of pigs has been developed in Catalonia, and is mainly aimed at the local market. For these reasons, being able to implement continuous improvement strategies to adapt the production of the pigs to the needs of consumers and ensure the success of this initiative, which is still in the development phase, is very important.

This project attempted to improve the production system of this variety in terms of fasting conditions, animal transport, the reduction of antibiotics during the transition phase, and adaptation to heat stress. By observing how all these factors affect the quality of the fresh meat, the aim is to provide a product with excellent pH, fatty infiltration, colour and tenderness.

02. Results and conclusions

Monitoring of the production data showed a difference of 7 days in reaching the target slaughter weight between the hottest and coldest seasons. However, the effect of reduced antibiotics and the two types of feed used did not show any significant differences in growth rates, as the genetic variants studied behaved in the same way in terms of production parameters. Nor were neutered males and females significantly different at the end of the fattening period.

The temperature of the animals just after slaughter was higher in warmer periods, which means a greater risk of pH levels unsuitable for optimal meat quality. Good management strategies are needed to minimise this effect. Neutered males had the greatest difficulty in lowering body temperature, possibly due to their higher level of fattening. The animals which fasted for 17 hours before slaughter had a lower percentage of intestinal weight in relation to their carcass weight, compared to those that

fasted only 7 hours beforehand. The measurement of intestinal weight could be a useful indicator to determine whether a batch of animals has been fasted correctly, in order to improve aspects such as pH (higher in fasted animals), animal welfare, financial yield, waste management and the risk of cross-contamination by faeces.

The meat from the Ral de Avinyó animals had high intramuscular fat values, which was higher in neutered males. The hardness ratings it received were very favourable, especially for the animals with higher pH. The same trend was observed in the cured loin and cooked ham pieces that were assessed during the study.

A protocol for transport could be defined to provide suitable conditions for the Ral de Avinyó variety.



Optimisation of product homogeneity and reduction of residual brine in the cured ham industry

Leader:

Boadas 1880, SA

Other recipient members:

Noel Alimentària, SAU

Other non-recipient members:

IRTA

Coordinator:

INNOVACC

01. Rationale

Cured ham production in Catalonia is an important part of the economy, as it is the pork product with the highest economic value. Despite its importance, cured ham has been described by various institutions as an unhealthy product due to its high salt content, but reducing salt levels is not an easy task due to the variability between batches, or even within a single batch.



In order to reduce the salt content, the variety of production must first be reduced. If it is possible to maintain both safety and quality as well as the desired texture and aroma, these products can offer the company a competitive improvement.

The first that must be taken into account is the identification and classification of the most suitable raw material for producing a cured ham that is low in salt, safe and with no sensory defects. It is then necessary to define the measures for improving during the salting stage aimed at reducing the variability of the salt content in the production. By monitoring this process, an intelligent readjustment that also reduces energy consumption during the drying process can be made. Finally, the ham must be characterised, classified and labelled correctly in order to include nutritional information and improve the product's competitiveness.

02. Results and conclusions

The results show that there is significant variation in fat content and weight of the raw material that reaches the companies to make cured ham. This variability can increase when there are different suppliers, and at the same time there are specific variations depending on the time of the year.

Weight and fat content are important factors that determine the process of salt acquisition by ham. For this reason, a variability in salt content was observed, with deviations of up to 3% just after the salting process. The different strategies evaluated in the project, such as flat salting and using the right amount of salt, categorising the raw material by weight and/or fat content and classification by salt content at the end of salting, are strategies that reduced the variation in salt between batches and within the same batch.

There are currently several non-destructive technologies available on the market for categorising the raw material. They are based on electromagnetic induction and X-rays, and can also be used to characterise the end product. X-ray equipment can be used to estimate the salt content of sliced and whole products, both on and off the bone, with errors of no more than 0.4%. Magnetic induction equipment provides estimates of salt content in fresh ham with an even lower margin of error, at between 0.1% and 0.3%. With cured products, the errors obtained with lean cured boned products are similar, but higher prediction errors are obtained for other types of product.

The modifications in the proposed process reduced the heterogeneity of the salt content in production. This was achieved by adapting the production process to the fat content of the raw material. However, this heterogeneity could be further reduced if other raw material quality parameters were taken into account, such as pH and water retention capacity, and by analysing variable factors throughout production.

Local production of high-quality flour with a high whiteness index

Leader:

Panificadora Alimentària, SL

Other recipient members:

Association of Extensive Crop Producers of Girona (APCEGI), Joan Llorens Torres, Montserrat Lleopart i Coll

Other non-recipient members:

Mas Badia Foundation

Coordinator:

Panificadora Alimentària, SL

01. Rationale

The quality of flour is largely determined by its colour, which is a parameter that can also condition consumer acceptance of the products that are produced. Flours with a high whiteness index have an L value greater than 95.

The colour of the flour is determined by many factors, but a key factor in obtaining flour with a high whiteness index is to sow varieties that give flour high L-values with a correct



application of growing itineraries in which nitrogen fertilisation and phytosanitary protection provide high hectolitre weights. For this reason, the usual practices of flour producers must be changed and the industrial process emphasised, and the extraction of flour in particular, in order to take into account the specific characteristics of each batch, such as the variety or the production area.

This project, led by the flour producing company PANIFICADORA ALIMENTARIA, S.L., is a response to the demand for local, quality flours with a high whiteness index, which could create an opportunity for the production of quality corn in Catalonia.

02. Results and conclusions

For long cycle wheat, in the last 3 years of research only the IPPON variety has presented L values above 95, and it is also the richest in protein with a percentage of 13.6%. However, the CAMARGO, NUDEL and RGT TOCAYO varieties also present high values. Only the RGT TOCAYO variety of short cycle wheat had an approximate L value of 95, followed by the ARTUR NICK variety. The results suggest that unlike long-cycle varieties, some of the whiter short-cycle wheat varieties are among those with the lowest protein content.

Regarding the impact of nitrogen fertilisation, the ARTUR NICK variety showed an increase in the percentage of protein as the amount of nitrogen added to the crop increased. A higher protein content was also observed when nitrogen was added to the second covers. In most of the plots, the protein content was higher when the surface nitrogen fertiliser was fractionated and part of it was applied in the flag leaf stage, compared to when it was all added at the start of stem elongation.

The colouring of the varieties of long cycle wheat was also found to have more variability, with values of between 94.6 and 95.4, compared to the short cycle varieties, with an average of 95. However, none reached a strength above 200. As for the effect of the flour extraction processes, both varieties reach a higher L value in the second milling.

The final results helped to produce a range of common wheat varieties that will be used to produce high quality flour with a whiteness index of $L > 95$. The other characteristics of this product are as follows:

- A hectolitre weight > 75 kg/hL
- Flour strength values (W) > 200
- A balanced P/L ratio
- A protein content > 13 %
- A falling number > 300

These varieties are suitable for the peculiarities of the different production areas without compromising the profitability of cereal farms.

Innovative solutions to reduce the use of nitrifiers in cooked meat preparations without affecting food safety and organoleptic quality

Leader:

Sant Dalmai, SAU

Other recipient members:

Esteban Espuña, SA, Joaquim Albertí, SA

Other non-recipient members:

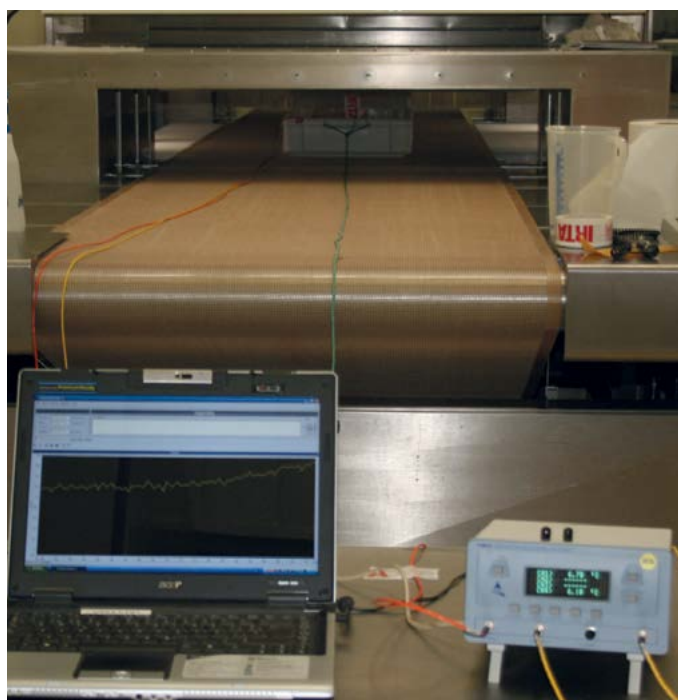
Autonomous University of Barcelona (UAB), IRTA

Coordinator:

INNOVACC

01. Rationale

The use of nitrates and nitrites in meat derivatives, a process that has been taking place for more than a century, has been highly controversial for the last 50 years. Many consumer associations and some professionals are now putting pressure on governments to reduce or even ban the total permitted dose. However, many scientists are at the same time gaining a deeper understanding of the endogenous metabolism of nitrogen oxide, which is obtained from the deamination of proteins, and they point out that the amount consumed in meat derivatives



is proportionally much lower than that produced endogenously. Analyses on its benefits as a cardio-regulator and antibacterial agent are also being carried out.

Companies manufacturing cooked meat products must ensure product quality over a very long shelf life (4 to 6 months), including in sliced products in many cases. It is therefore essential to maintain the addition of nitrite to ensure its safety, as only a part of the added nitrite is present after cooking, and it must remain active throughout the marketing period. This ensures that the quality and microbiological safety of the products is maintained.

This project arose as a result of companies' concern to ensure the safe use of nitrifying salts for consumers' health, and it studied the kinetics of nitrifiers in cooked meat products and their antimicrobial effects. From the information obtained, companies will be able to propose new formulations for their products and will have a better understanding of how to apply nitrites during the product manufacturing process in order to ensure food safety and prolong its shelf life.

It is very important to determine the procedures that must be carried out to avoid losses of functional nitrite during processing for this reason. The parameters that help to preserve its functionality and the chemical and technological adjuvants that enhance the functionality of the residual nitrite must also be analysed.

02. Results and conclusions

Studies of commercial products have shown that changes in nitrite levels are highly variable and associated with variability in the pH of the foodstuffs and the manufacturing process. The results show a very significant reduction in the concentration of nitrite in cooked products, especially when compared to the amount added to the formulations, including the range of addition, which rises from 85 ppm to a maximum of 150 ppm NaNO_2 . This means that in the middle and at the end of the useful life of the products, the nitrite residue is very close to or below the detection limit ($\text{LOD} = 4 \text{ ppm}$) in most cases.

Meanwhile, in the products studied such as extra cooked ham, cold cuts of shoulder, turkey breast and bacon, a significant presence of nitrates not intentionally added to the recipe is observed, in a range between 20 and 40 ppm. These nitrates are partially those already present in fresh pork and drinking water.

In the preparation of the brine, the increase in ascorbate concentration encourages the transformation of nitrite into nitrate, as shown by the results of the analyses carried out 48 hours after the preparation. Adding protein to the brine also significantly affects the presence of nitrifiers. Finally, aeration by vortex agitation and the presence of a significant amount of ascorbate have no significant effect on the transformation of the nitrite.

WETWINE: innovations in the application of constructed wetlands at wineries

Leader:

Celler la Vinyeta

Other recipient members:

Codorníu, SA

Other non-recipient members:

Environmental Chemical Engineering Group (University of A Coruña), IRTA, INNOVI Association of Innovative Companies, Empordà Designation of Origin Regulatory Board

Coordinator:

Aralora, SL

01. Rationale

Wineries generate a great deal of wastewater and vinasse during winemaking, which is often not used. The overall objective of the WETWINE project was to test two different systems based on wetlands constructed for the on-site treatment of this wastewater and sewage sludge, so that the waste can then be used to create a circular economy circuit.

The first system was implemented at the La Vinyeta winery, located in Mollet de Peralada. To treat the wastewater, a pilot demonstration system was installed combining a hydrolytic up-flow sludge bed (HUSB) and a horizontal flow artificial wetland in order to produce treated water of sufficient quality to be either discharged into the public watercourse or reused for irrigation. A sludge drying reed bed (SDRB) was created for treatment of the sludge. This allows the sludge from the digester, after to be added to the soil as a fertiliser for the vines after it has been dried and stabilised.

At the Raimat winery, which is located in Raimat and part of the





Codorniu group, the second system based on a pilot plant was tested to check the effect of an innovative method of sludge dewatering using sludge drying reed beds (SDRB). The system was conventionally designed, but the innovative management of the sludge feed sought to optimise the surface area required to achieve stabilisation, in order to reduce the investment costs. The results obtained in this pilot project have been applied in order to establish the design and cost of an SDRB system to treat all sludge generated at the biological activated sludge plant at the Codorniu winery in Sant Sadurní d'Anoia.

02. Results and conclusions

The results of La Vinyeta show that the system correctly integrates all the elements. The hydrolytic up-flow sludge bed (HUSB) is able to retain a large part of the suspended solids and to compensate adequately for variations in the wastewater flow from the winery. Adequate levels of efficiency were also maintained for the two hydraulic retention times tested. The degradation of part of the organic matter in the HUSB digester and the subsequent elimination of contaminants in the HSSF wetland provide an effluent with sufficient quality for discharge or reuse in irrigation. However, it still requires further development to achieve maximum efficiency. The sludge dewatering system is sized for the potential volume of sludge generated by the HUSB digester.

The system proposed by La Vinyeta is suitable for the treatment of wastewater generated by the winery and its subsequent use

for irrigation or discharge into the waterways. However, this can only be confirmed once it reaches maximum efficiency. For the moment, it has been demonstrated to consume 3% of the energy used by the activated sludge system, and it may be even less, as gravity flows are used. Furthermore, no chemicals need to be added in the process.

The results obtained at Raimat show that it is entirely feasible to have a definitive plant consisting of a sludge dehydration reed-bed which, thanks to the management of its biological treatment plant, provides a stabilised sludge which can be applied as fertiliser to vines. A feed with an average value of 20 kgTS m⁻² to -1 for the commissioning phase, and 40-50 kgTS m⁻² to -1 as a design load is recommended. The financial investment would thereby be fully repaid after about 5 years.

The stabilisation rate for sludge from the biological WWTP treating wastewater from the winery was found to be similar to that observed for sludge from urban WWTPs. Both fresh and treated sludge comply with the limits stipulated for the presence of heavy metals in sludge intended for agricultural use, irrespective of the pH of the soil.

This sludge dewatering system generates 70% less CO₂ emissions than centrifuge treatment, and does not require the addition of reagents, coagulants or polyelectrolytes. A comparative life cycle analysis (CLA) shows that this is an impact 1,000 to 6,000 times lower than other more common systems such as centrifuge and transport to a municipal WWTP.

WINESITY: automatic sensor to continuously measure density during the wine fermentation process

Leader:

Agrícola Falset Marçà i S.C. Afalma SCCL

Other non-recipient members:

Innovació i Recerca Industrial i Sostenible, SL (IRIS), Wine Industry Technology Park Foundation (VITEC), Catalan Federation of Agricultural Cooperatives (FCAC)

01. Rationale

The Winesity project aims to develop a density measuring system to continuously monitor the fermentation processes during winemaking, given that the density of must declines during its transformation into wine. Fermentation control is essential for ensuring the excellence of the product, as fermentations that are too fast can affect the quality of the product and conversely, too long a fermentation time increases the risk of damage and energy expenditure.

By monitoring the fermentation curves, it is possible to detect issues during the vinification process and to react in time to prevent an irreversible problem that in the worst case scenario could lead to the loss of hundreds or thousands of litres of product. This process is carried out with a sensor that is placed inside the fermentation tanks. However, its position and protection is an important issue to take into account, as it must be able to withstand the working conditions inside the tank, such as gas bubbling, the movement of the grape skins, recirculation and tartrate deposition. The density results are sent to a computer, where the Winesity software displays the density and temperature values continuously for each tank.

The overall objective is to determine the optimal design and production of the automatic density meter for monitoring fermentation during vinification. This was carried out with the construction of prototypes that were placed in various tanks belonging to the Cooperative to test their operation during the harvest season.

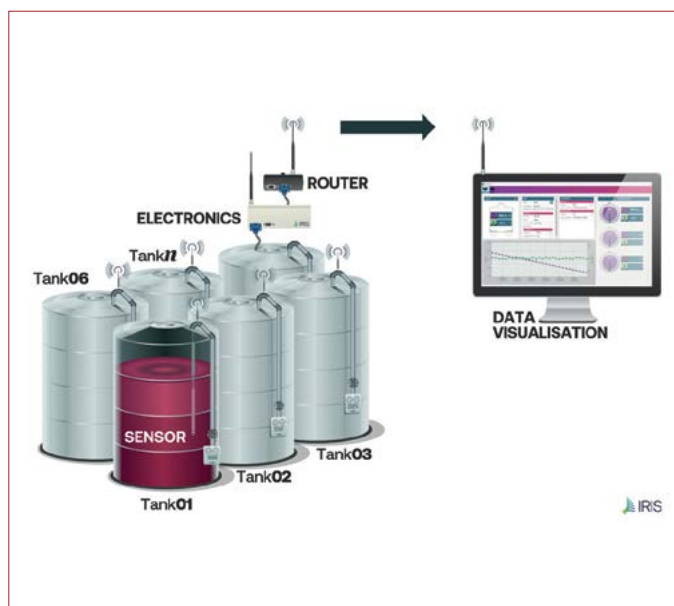
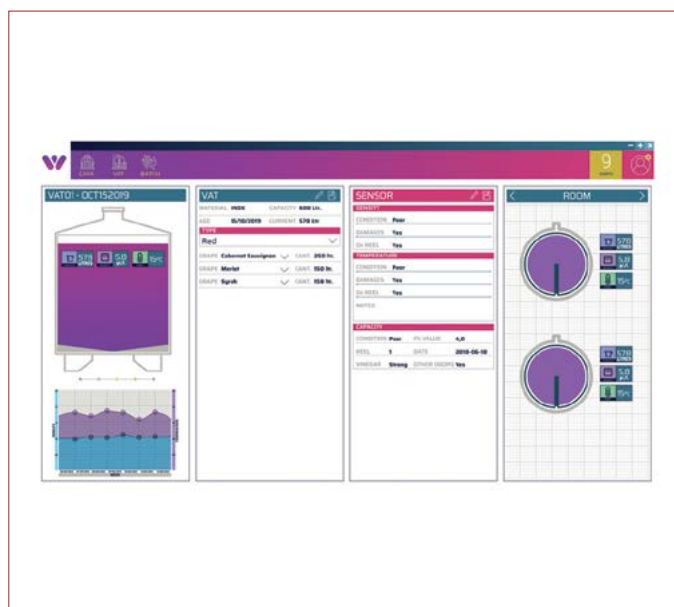
02. Results and conclusions

All the actions carried out have determined the advantages obtained with the Winesity sensor. First of all, the system allows the processes taking place in the fermentation tanks to be monitored at all times thanks to its connection to a display computer.

Applied on a large scale, the sensor will also help to greatly reduce staff time by changing the system from manual to automatic. This will mean that the oenologist will not have to carry out this task during the harvesting season, which is the time of the year when there is the most work, and it makes it easier for any operative to carry out this task.

Other clearly evident advantages are the detection of problems or issues in the fermentation process and the faster release of fermentation tanks. The latter factor reduces or avoids the need to subcontract other wineries to process surplus grape stock, due to lack of resources or space, and can lead to an increase in wine production of up to 15%.

The study has also led to improvements in both the mechanics and electronics of the sensors for tanks with a capacity of 33,500 litres.

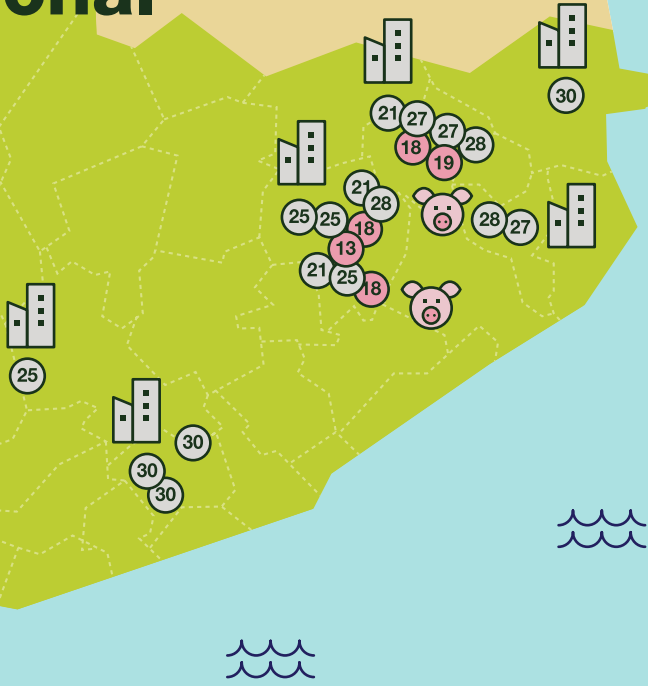


Operational Groups

2017



Generalitat de Catalunya
Departament d'Acció Climàtica,
Alimentació i Agenda Rural



LIVESTOCK FARMING

- 13 | Development of a technology for the monitoring of all the liquid manure from a farm on an annual basis in order to determine its nutrient content (n, p, k) using nir (near-infrared) technology and its volume using sensors.
- 18 | Selection of feed for gilt pigs to improve the lipid profile of high-quality cured sausages.
- 19 | Bovine livestock waste recovery and reuse.



AGRI-FOOD INDUSTRY

- 21 | EMBOT-ITS: Use of advanced technology and big data management to optimise sausage drying rooms
- 25 | MATSOS: More sustainable plastics for use in the meat industry.
- 27 | Production of pig fattening standards for Reial d'Avinyó pigs to produce optimal quality pork
- 28 | Optimisation of product homogeneity and reduction of residual brine in the cured ham industry.
- 30 | Innovative solutions to reduce the use of nitrifiers in cooked meat preparations without affecting food safety and organoleptic quality.

We talk to:

SERGIO PONSÀ

UVIC-UCC BETA Technological Center

Sergio Ponsà Salas is a chemical engineer and holds a PhD in environmental science and technology. He is the director of the BETA Technological Centre, and the coordinator of the centre's research group. He is an expert in biological processes for the treatment of solid waste and its recovery, including composting, anaerobic digestion and biodrying.

"The Operational Groups have encouraged the sector's institutions to approach research centres to share challenges and needs and work together"

MARIONA PRATDESABA

INNOVACC

Mariona Pratdesaba Rovira is an agricultural engineer and holds a master's degree in Environment from the University of Girona (UdG). She has been coordinating collaborative innovation projects at INNOVACC for six and a half years. She currently holds the position of project manager.

INNOVACC is the Catalan meat and alternative protein cluster which was created in 2008 and is based in Olot (Garrotxa), but it works all over Catalonia. It currently has 109 partners across the value chain.

"Being involved in a project like the Operational Groups is very enriching. It allows you to learn in different ways: new technologies, new ways of working, improving the quality of the end product, etc."

SERGIO PONSÀ

Are you satisfied with the achievement of the project objectives? Are the results of the project in line with your initial expectations?

For us, an Operational Group is always an opportunity to work hand in hand with companies and organisations in the agrifood sector and use our knowledge to solve a challenge. From this perspective, we can only make a positive assessment, even in projects where the results have not been ideal in terms of resolving a short-term need. In those cases, the Operational Groups have opened the door for us to continue working in other ways, so that in one way or another we have met the expectations we had set at the outset.

How has the project contributed to the innovation culture of your company/organisation?

The Operational Groups have been a fundamental tool for transferring knowledge and technologies to the agrifood sector and for promoting and facilitating much-needed collaboration between companies, farmers and livestock farmers and R&D&I centres and universities.

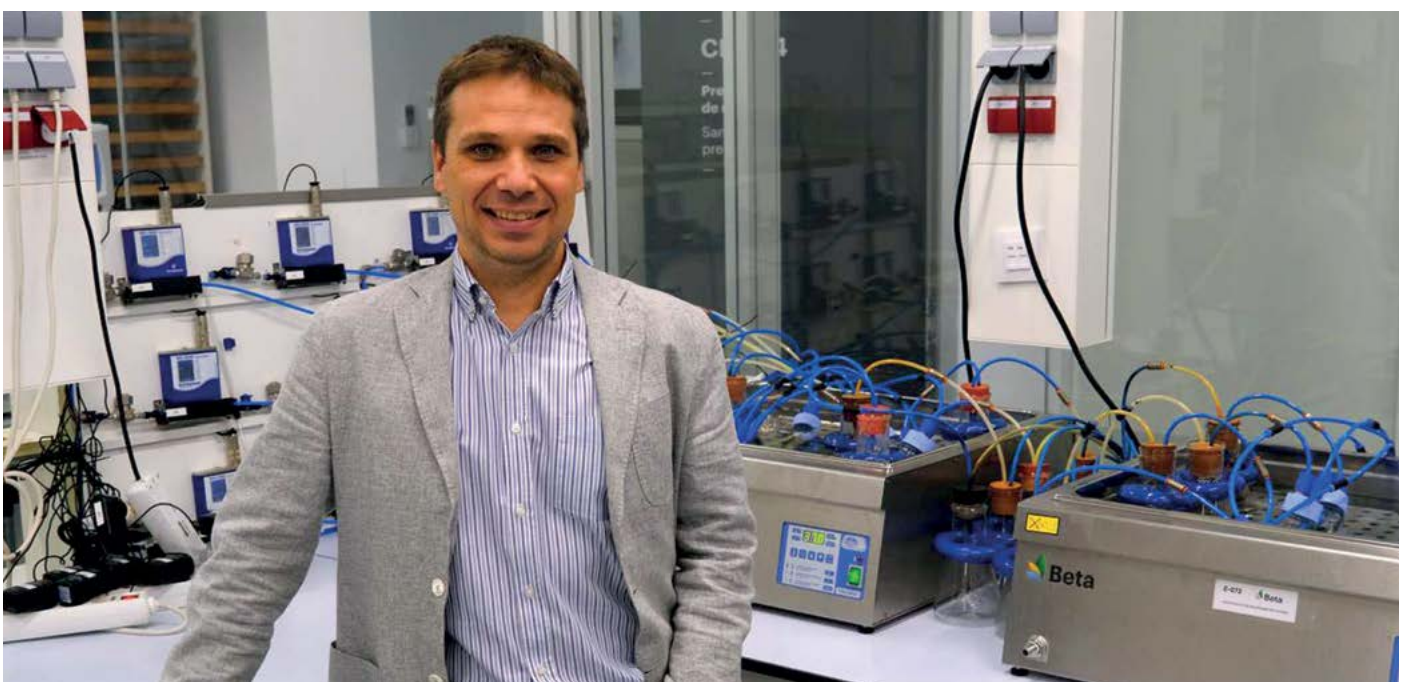
Having this tool at our disposal therefore helps us to focus our competitive research and innovation projects, knowing from the outset that we will be able to use calls by Operational Groups to be able to transfer the knowledge and results obtained to the productive sector.

The Operational Groups have also encouraged the institutions in the sector to approach us and other research centres to share challenges and needs so that we can work together to find solutions to improve the competitiveness and sustainability of the Catalan agrifood production sector. As you have the opportunity to learn about other points of view on the same problem, the approach you take to your own research also changes. This has helped us a great deal in being recognised as a reliable partner in our territory.

Will what you have achieved with this project open the door to future initiatives?

I'm sure it will. As they are innovation projects on a scale close to their real application (prototypes, experimental fields, etc.), the results obtained tend to have a lower risk of not being extrapolated or applicable in real production systems. This makes it easier to continue working with the various beneficiary institutions of the Operational Groups on subsequent initiatives that enable their results to be capitalised and applied. For example, there have been institutions in the agrifood sector that have been able to apply for patents based on the results of the Operational Groups in which we have participated.

Apart from that, the results of the Operational Groups can also lead to further work on other more far-reaching innovation projects to further improve and move closer to real applications. The instruments with the greatest potential may be the Horizon Europe (formerly Horizon 2020) and LIFE programme calls.



Moreover, joint work can continue between the research centres and the beneficiary institutions of the Operational Groups in these programmes. At the BETA Technological Centre we have very positive experiences in that respect: some Operational Groups have allowed us to establish solid links with actors in the region, which have subsequently made it easier for them to support us on other much larger projects, and even to commit to innovation and transfer with their own resources.

What is your overall assessment of the experience?

From day one, we have set out to be useful in the territory and in the sector and to work towards being a relevant actor in the field of sustainable rural development. The Operational Groups have become a very important tool for us to put this philosophy into practice.

So in general, our experience as participants in this funding programme has always been very satisfactory. You only have to consider how since its beginnings, the BETA Technological Centre has been firmly committed to this type of project, and that will continue because we believe that they are a basic tool for promoting innovation in the agrifood sector and fostering collaboration between private institutions and research and innovation institutions.

How would you describe your level of personal satisfaction after the project?

The Operational Groups have played a very important role in enabling us to fulfil the mission and vision we set for ourselves at the BETA Technological Centre. We have always been very clear that our professional objective is to transfer knowledge and technologies to the agrifood production sector in order to make it more sustainable and competitive, and the Operational Groups are a very important tool for achieving that.

So personally, but I think I also speak on behalf of my colleagues, we are always very satisfied with these projects.

I am confident that the level of satisfaction of the partners we have worked with is also high, bearing in mind that we are in touch with almost all of them to continue looking for new opportunities for collaboration, and we are already working together on other projects and activities in many cases.

What difficulties have you encountered during the project in translating research into practice?

It is important to remember that we are talking about innovation projects on a significant scale, so the risk that the results will not be as expected is lower than in normal research pro-

jects. However, sometimes things unfortunately do not go as anticipated, or the results are not sufficiently optimal or do not go as far as expected.

For those of us who are also involved in more basic research projects, this could always happen, and it happens more often than we would like. But the world of private institutions tends to work at a very different pace from our own, and we are always looking to reduce the risk of not meeting expectations. This is not a difficulty specific to this call, but it is an issue that is always present and one which ends up affecting many dynamics in R&D&I.

However, being able to support these activities through the funding of an Operational Group helps to overcome some of these barriers. On the one hand, the company does not assume all the risk involved in a highly innovative venture, since the funding for these projects is very important, and on the other hand, any experience ends up being part of a short-, medium- or long-term solution.

How do you rate the general work dynamic of Operational Groups?

The working dynamic is always one of the challenges that needs to be resolved as well as possible from the outset. As I said before, we try to create a relationship of trust with the companies and institutions that are part of each Operational Group, which is often there already, but sometimes is not. At this point I would like to highlight the role that the institution acting as coordinator of the Operational Group can play. At the BETA Technological Centre we have had very positive experiences of working with clusters and similar organisations, for example.

Furthermore, I believe that the Operational Groups are a tool for activating and fostering innovation in the Catalan agrifood sector. A tool that enables innovation in the sector and puts in contact and allows it to work together with research centres, technology centres and universities. All of this creates very positive dynamics, both for the sector itself and for the Catalan research ecosystem.

MARIONA PRATDESABA

Are you satisfied with the achievement of the project objectives? Are the results of the project in line with your initial expectations?

INNOVACC coordinated six projects by Operational Groups in the 2017 call. Achieving the objectives as the projects were carried out was positive. The results were more immediate and applicable in some projects, and therefore in line with ex-



pectations. In other cases, implementation took place later.

How has the project contributed to the innovation culture of your company/organisation?

Operational Group projects always have a positive impact on the organisation and its innovation. Valuable first-hand knowledge is acquired.

Will what you have achieved with this project open the door to future initiatives?

Many of the projects carried out have been continued and further work has been done on the basis of the results obtained. So the results could be implemented at the company level first of all, and at the same time, the areas of interest to companies could be developed further.

What is your overall assessment of the experience?

Participating in this type of project and being able to coordinate it is a positive experience for INNOVACC. You gain innovative knowledge, and you can also see how companies work and how they evolve thanks to the project, you are up to date with what the research centres and universities involved are working on. It is also a way of getting to know new companies, making contact and being able to collaborate actively.

How would you describe your level of personal satisfaction after the project?

Personally, coordinating or being involved in a project with

the characteristics of the Operational Groups is very enriching. It allows you to learn in different ways: new technologies applied in the agrifood sector, innovations and ways of working to achieve improvements in farms and also in the quality of the end product, new, more sustainable packaging materials, etc. So it keeps you up to date with the agrifood sector in Catalonia and at the same time, it allows you to learn about the lines of work at research centres and universities.

What difficulties have you encountered during the project in translating research into practice?

The transition to practice has been straightforward in some cases, as the project's applicability was taken into account from the outset. In other projects, the obstacle has been scaling up the methodologies developed in the pilot plants at the research centres to an industrial level. In some cases, further work along other lines is necessary to achieve a technically and economically viable industrial scale-up.

How do you rate the general work dynamic of Operational Groups?

In most cases, the working dynamic is usually very flexible. However, sometimes the dynamics are more complicated. In the case of the Operational Groups in the 2017 call, the COVID-19 pandemic happened in the middle of their development. That put a stop to the work and the work schedules had to be adapted to the workplace restrictions of the various participants. However, all the projects were completed within the deadlines set by the call for proposals.

