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DossierTècnic

Innovation and knowledge transfer

September 2023

Operational Groups in Catalonia. 2018 call

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

Rural Cat

Contents

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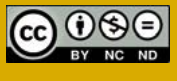

Joan Gòdia Tresànchez
Director-General of Agri-food Companies, Quality and Gastronomy

Operational Groups are crucial actors for innovation in agri-food and forestry.

The EU's common agricultural policy (CAP) supports a modern, market-oriented agricultural sector to ensure safe, affordable and high-quality food, produced sustainably and respecting consumer standards, as well as supporting investment in the rural economy. The new application model sets goals and evaluates the results obtained.

The CAP Strategic Plan (CAP Strategic Plan 2023–2027) contains the interventions or measures to be implemented to achieve the objectives of the CAP and the European Green Deal, based on a thorough analysis of the needs of the agricultural sector -including their diagnosis, identification and prioritisation- and the rural environment as a whole in relation to each of the CAP objectives. Thus, the Plan aims at the sustainable development of agriculture, food and rural areas to guarantee food security for society through a competitive sector and a vibrant rural environment. For this reason, part of the CAP budget is allocated to developing agricultural and livestock practices that are beneficial to the climate and the environment.

In order to respond to the CAP objectives, priority will be given to all those interventions aimed at improving knowledge transfer and exchange. The main actors in this regard are the Operational Groups, which will be fundamental to the drafting and execution of projects within the framework of the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI). It should also be noted that the new Operational Groups measure has been developed with Agricultural Knowledge and Innovation System (AKIS) in mind. These systems seek to promote the flow of knowledge between public actors, producers, advisers, training centres and, in general, any actor related to the agri-food sector, and to encourage their cooperation in order to develop a competitive and sustainable agriculture.

In Catalonia, the current scenario requires the adoption of active and shared strategies that identify opportunities to build a sustainable, safe, resilient and healthy food system that everyone can access. It is therefore necessary to have an individualised and shared national food policy. The Catalan Strategic Food Plan (PEAC) 2021–2026 has been drafted to develop this food policy. This Plan is an interdepartmental and intersectoral instrument that lays the foundations for the National Pact for Food of Catalonia. On the other hand, the Innova 2030 Plan, the agri-food sector innovation strategy, aims to provide Catalonia with the tools it needs to improve the agri-food innovation system. Grants for cooperation between the Operational Groups constitute one of the actions available in this strategy in order to promote innovation in the Catalan agri-food and forestry sector, which at the same time are integrated within Catalonia's food policy.

These grants for cooperation between Operational Groups are not new, as the first call was issued in August 2015. Thanks to the experience gained and all the knowledge we have received from the sector and the key players from the rural world, today we present the results of the 35 pilot projects of the 2018 call, which were completed in 2021. This figure represents a significant increase in the number of both projects and participating entities. We would like to emphasise the importance of these Operational Groups as essential players for innovation in agri-food and forestry. For this reason, the Department of Climate Action, Food and Rural Agenda has substantially increased the resources initially allocated to these grants. These groups have worked non-stop to achieve a sustainable production model that is more respectful of the environment. Since we are aware of the difficulties that this entails, we would like to thank each and every one of the people and groups involved for the effort and enthusiasm that they have shown over the last few years and encourage them to continue to innovate collaboratively in future stages.

EIP-AGRI OPERATIONAL GROUPS IN CATALONIA: 2015–2023

01. Introduction

The European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) is an initiative that aims to promote innovation and improve the exchange of knowledge in the agri-food and forestry sectors. To achieve this, the EIP-AGRI operational groups work as a team and in cooperation to carry out an innovation-focused project with the aim of turning novel ideas into real solutions for the sector.

As part of the previous Rural Development Programme of Catalonia (PDR) 2014–2022, the Department of Climate Action, Food and Rural Agenda (DACC) has published six calls for Grants for Cooperation for Innovation between 2015 and 2021. These grants, developed through Operation 16.01.01 of the Catalan Rural Development Plan, consist of two types of actions. First is the line of grants for the drafting of EIP-AGRI operational group projects (intended for projects that are still in their early stages and that require planning before carrying out a pilot programme). Second is the line of grants for implementing innovative pilot projects carried out by the operational groups. These grants are 43% co-financed by the European Agricultural Fund for Rural Development (EAFRD).

Since the initial call in 2015, these grants have been very well received within the agri-food and forestry sectors, which have actively participated in presenting projects. To respond to this demand and promote innovation in the sector, it has been necessary to increase the budget planned for the operation, which was initially set at 17.6 million euros. Currently, the pilot projects corresponding to the latest call, put out in 2021, are still in the implementation phase. It is expected that once these projects are completed, in 2024, the total amount expended for this operation within the framework of the 2014–2022 RDP will be around 29 million euros.

Regarding the new programming period, this type of project will receive continued support to accelerate innovation in the agri-food and forestry sectors. In the same vein, the 2023–2027 CAP Strategic Plan has planned for 7161 Grants for Cooperation among Operational Groups of EIP-AGRI.

Type	Sector	Number of projects	Number of beneficiaries	Total approved budget
Drafting (planning)	Agricultural	25	25	€303,133
	Forestry	16	16	€196,632
	Agri-food industry	21	21	€237,730
	Animal Husbandry	12	12	€162,522
	Total	74	74	€900,016
Implementation (pilot)	Agricultural	73	250	€9,660,876
	Forestry	11	40	€1,056,529
	Agri-food industry	74	256	€10,169,450
	Animal Husbandry	52	172	€7,394,676
	Total	210	718	€28,281,531
	Sum total	**284**	**792**	**€29,181,547**

Table 1. *Summary of approved projects and budget distribution by type of project and sector (calls between 2015 and 2021). Source: https://grupsoperatius.cat (CTFC – RuralCat).*

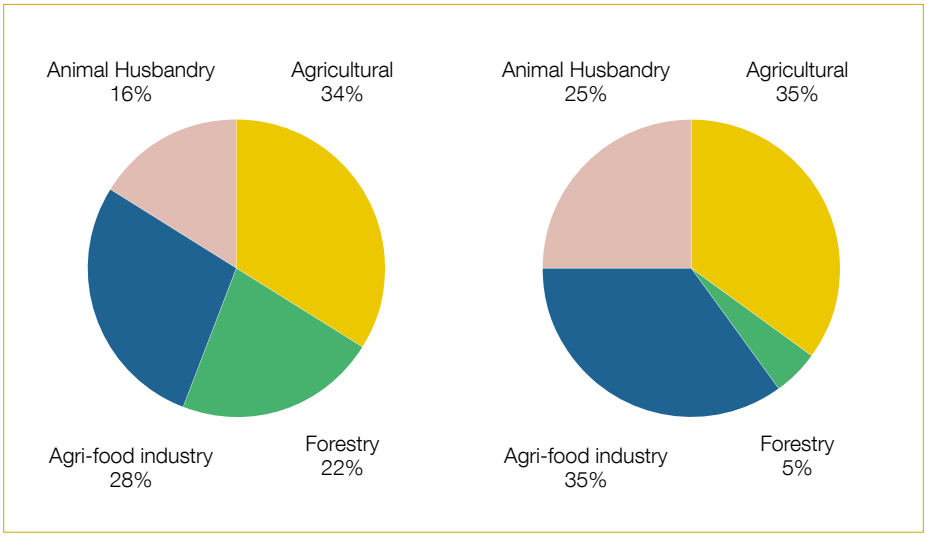

Figure 1. *Distribution by sector of the 74 drafting projects (left) and the 210 pilot projects (right) (calls between 2015 and 2021). Source: https://grupsoperatius.cat (CTFC – RuralCat).*

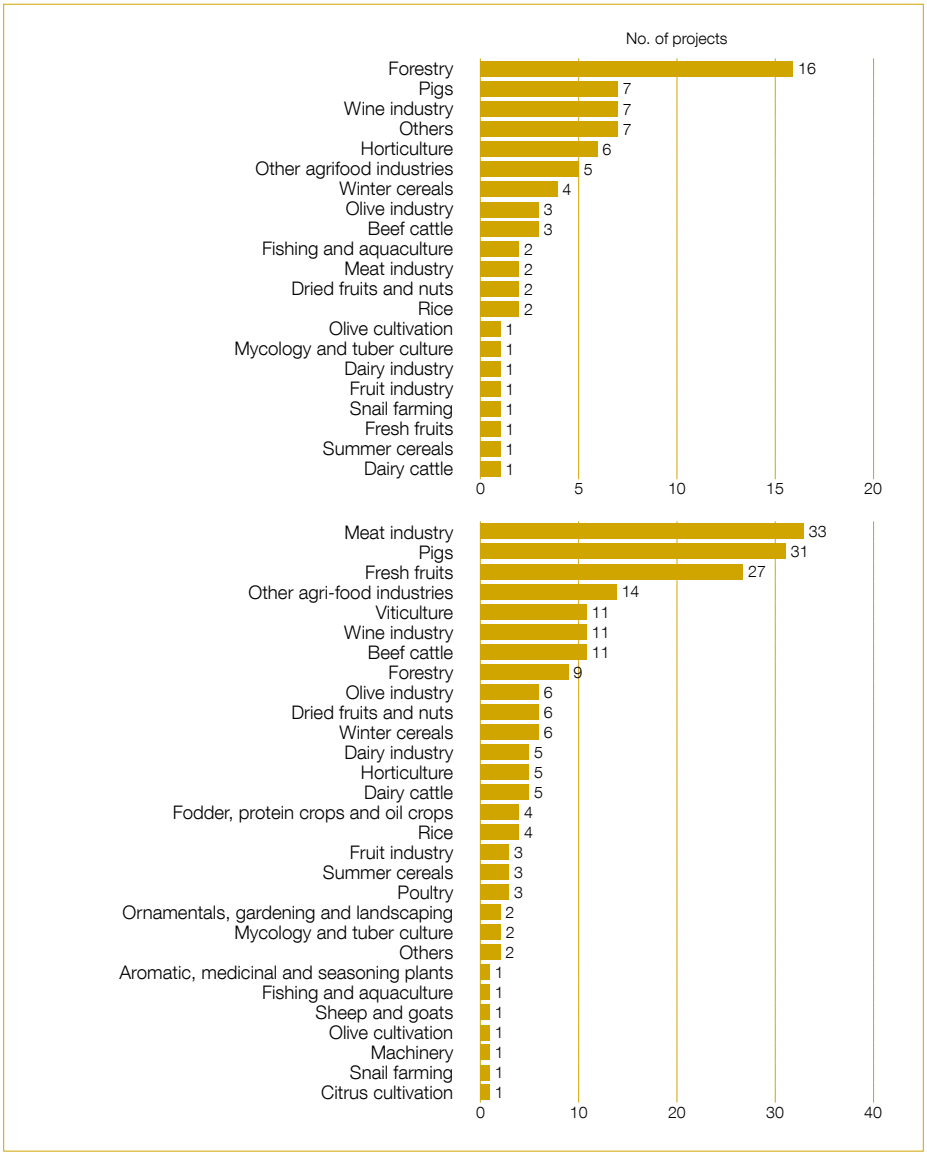

Figure 2. *Distribution of projects by subsector (2015–2021). Drafting projects (above) and pilot projects (below) (calls between 2015 and 2021). Source: https://grupsoperatius.cat (CTFC – RuralCat).*

The main execution data of the projects carried out by the operational groups in Catalonia in the 2015–2023 period are presented in this article. This data, which can be consulted in the Operational Groups Observatory related to the DACC's Xarxa-i.cat network, has been analysed and collected in the document *Aggregate Analysis Report of Operational Groups Innovation Projects 2015–2021 - June 2023* prepared by the Forest Sciences and Technology Centre of Catalonia (CTFC).

02. Approved projects and distribution by sector

A total of 284 projects -74 drafting projects and 210 innovative pilot projects- have been approved in the 2015–2023 period. These projects have involved a total of 792 beneficiary companies or entities.

Table 1 and figure 1 show the budget distribution by project type and sector. Regarding the implementation of pilot projects, the agri-food industry and the agricultural sector have been the sectors with the largest number of approved projects, each with approximately 35% of all projects. They are followed by the livestock sector with 25% of projects, and finally the forestry sector with 5%.

The agricultural sector has been the largest sector in the drafting of projects, with 34% of approved projects, followed by the agri-food industry (28%), the forestry sector (22%) and, finally, the livestock sector (16%).

03. Distribution by subsectors and areas

As figure 2 shows, the forestry subsectors have the largest prescence in the drafting of projects, with22% of approved projects. They are followed by the pig subsector with 9%, the wine industry also with9% and horticulture at 8%.

Regarding innovative pilot projects, the meat industry subsector represents the largest share with 16% of approved projects, followed by pigs at 15% and fresh fruit with 13%.

With respect to the project areas, the data confirms the trend already observed in the first calls, with a prevalence of projects related to the development of new products, processes or services. These are followed by projects related to product quality and commercialisation. It should be noted that, for pilot projects, the main areas are for those focusing on food, health and animal welfare and those related to plant protection, soil management and fertilising.

04. Territorial distribution

Figure 3 shows the territorial distribution of the 792 beneficiaries of the projects. Girona and Barcelona are the territories showing the largest participation, followed by Central Catalonia and Lleida. These are followed by Tarragona and Terres de l'Ebre. Alt Pirineu and Aran have also participated, but in smaller numbers.

05. Type of beneficiary entity

As figure 4 shows, cooperatives lead the number of beneficiaries of drafting projects, followed by agricultural companies and agricultural and forestry producer associations. On the other hand, agri-food industries are in first place in the implementation of pilot projects, followed by agricultural companies and cooperatives. They are closely followed by the research centres that have received grants for project coordination.

It should be noted that a total of 33 different entities from the RDI system have participated in the implementation of the 210 innovative pilot projects carried out in the 2015–2023 period.

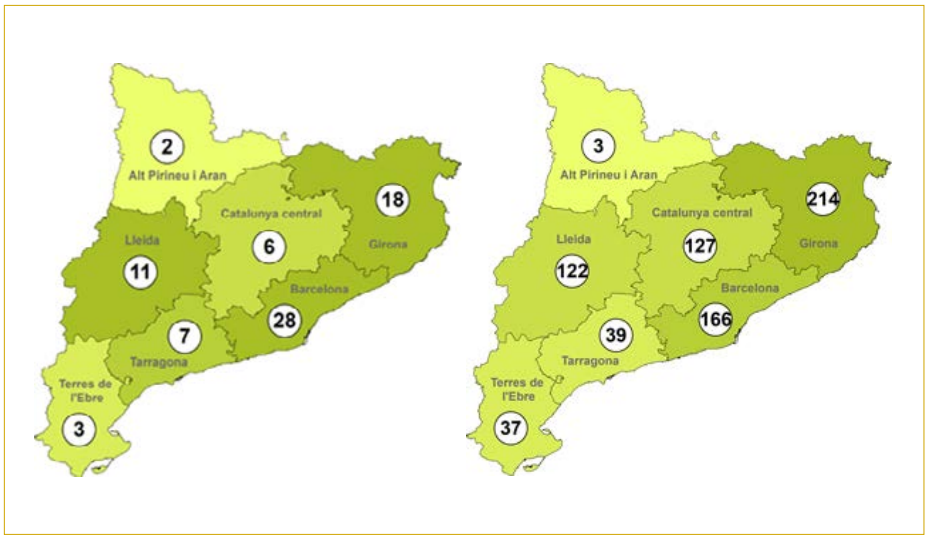

Figure 3. *Territorial distribution (number of beneficiaries) of drafting projects (left) and of pilot projects (right) (calls between 2015 and 2021). Source: https://grupsoperatius.cat (CTFC – RuralCat).*

06. Main results and conclusions

The project data collected in this summary article have been analysed in depth to assess the impact of the operational groups on the agri-food and forestry sectors. The 2023 report *Analysis of the Impact of Operational Groups in Catalonia* written by the Centre for Research in Agri-food Economics and Development (CREDA) gathers the main conclusions obtained from the analysis of this data and information provided by the grant beneficiaries and coordinators.

According to this report, the operational groups favour the transmission of knowledge between research entities of the RDI system and actors in the agri-food sector, with mechanisms such as the creation of coordination structures between the operational group members and the incorporation of training plans within the participating organisations.

The calls for operational groups have favoured the commercialisation of new products or services and the introduction of new production methods (figure 5). In addition, a growing percentage of organisations have brought new products to the market or commercialised disruptive innovations. Beyond technological innovations, operational groups calls for proposals increasingly promote introducing marketing innovations.

Job creation in medium or large organisations is observed as the main social impact generated. Related economic impacts show a mixed picture, with an increase in the percentage of organisations having to deal with increased costs but that also increase their productive capacity.

To find out more

RuralCat website – Xarxa-i.cat:
https://ruralcat.gencat.cat/xarxa-i.cat

Xarxa-i.cat – Operational Groups Observatory:
https://grupsoperatius.cat

RuralCat Website – Operational Groups Search Engine:
https://ruralcat.gencat.cat/web/guest/xarxa-i.cat/grups-operatius

EIP-Agri Network website:
https://ec.europa.eu/eip/agriculture/en/node.html
https://eu-cap-network.ec.europa.eu/index_en

		No.	Total approved budget
Drafting (planning)	Cooperative	18	€204,826
	Agricultural company	14	€196,088
	Group/association of agricultural or forestry producers	14	€163,432
	Group/association of agri-food or forestry industries	10	€115,589
	agri-food industry	9	€111,472
	Forestry company	5	€64,635
	Other agents in the sector	4	€43,974
	Total	**74**	**€900,016**
Implementation (pilot)	agri-food industry	261	€12,951,898
	Agricultural company	130	€6,150,310
	Cooperative	129	€5,460,029
	Research Centre	47	€529,751
	Other agents in the sector	45	€635,440
	Group/association of agricultural or forestry producers	31	€567,440
	Forestry industry	24	€475,316
	Group/association of agri-food or forestry industries	21	€552,284
	Irrigator community	9	€318,596
	Forestry company	7	€343,218
	Service or technology company	6	€72,858
	Local LEADER action groups	5	€190,546
	University	3	€33,845
	Total	**718**	**€28,281,531**
	Total sum	**792**	**€29,181,547**

Figure 4. *Types of beneficiary organisations (2015–2021). Source: https://grupsoperatius.cat (CTFC – RuralCat).*

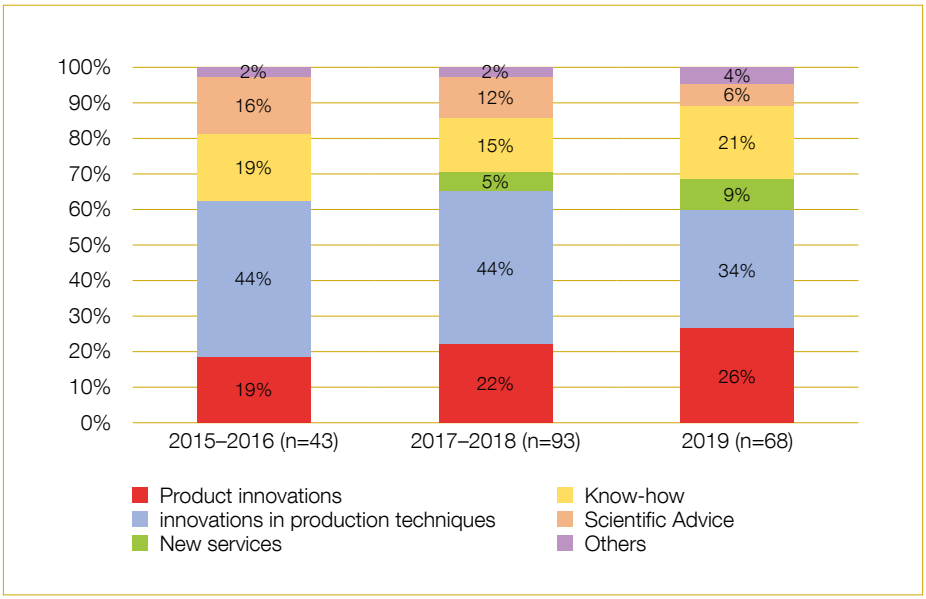

Figure 5. *Evolution of the direct results of operational groups per completed call, expressed as a percentage of entities according to the type of result obtained (calls between 2015 and 2019). Source: CREDA.*

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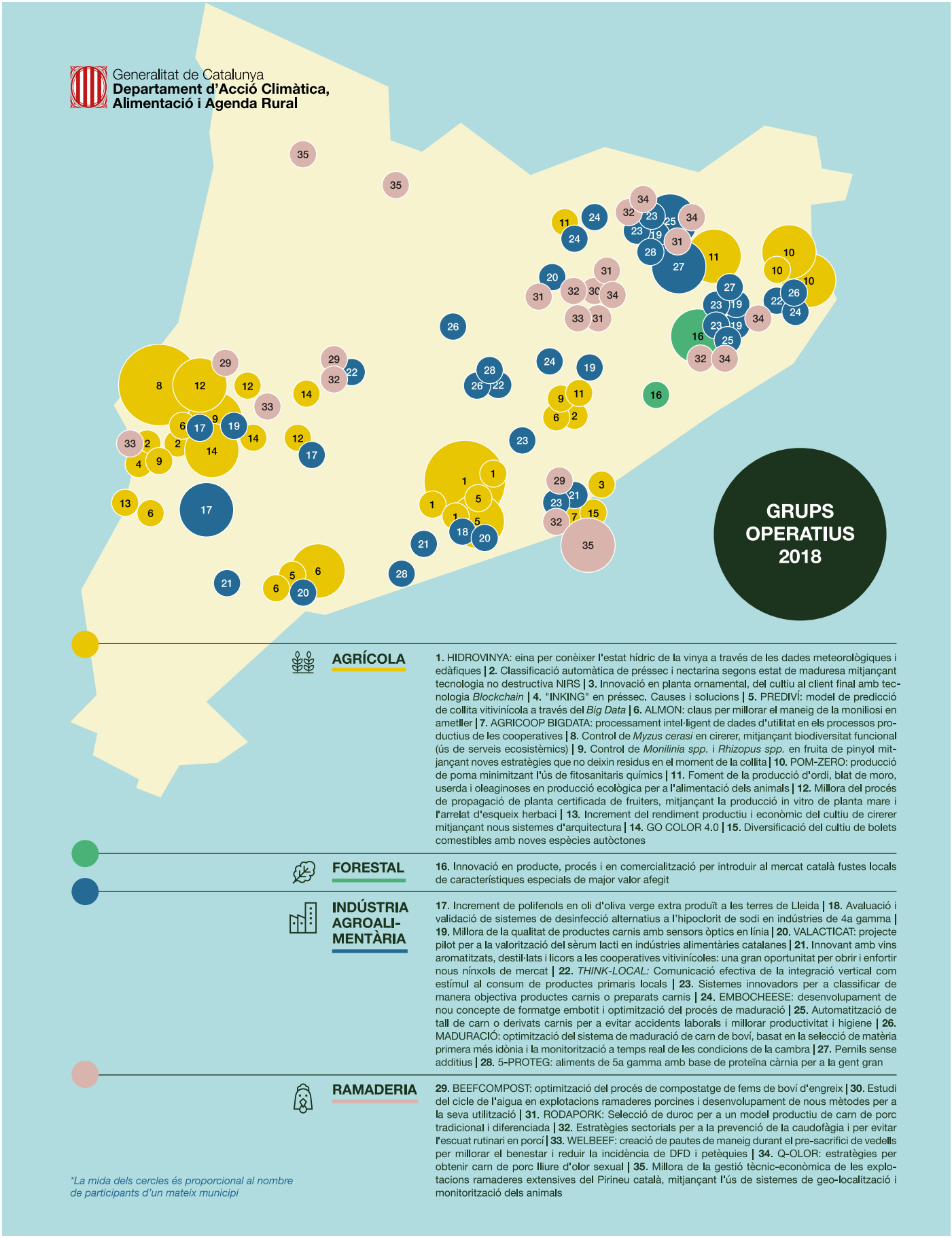


"Projects cofinanced through Operation 16.01.01 (Cooperation for Innovation) under the Rural Development Programme of Catalonia 2014–2022.

1

HIDROVINYA: a tool to ascertain the state of water resources in vineyards through meteorological and soil data

Leader:
ADV SANT LLORENÇ - PENEDÉS SUPERIOR

Other recipient members:
CODORNIU, SA, GRAMONA, SA, JUVÉ & CAMPS, SA, ADV SANT MARTÍ PENEDÈS SUPERIOR

Non-recipients:
INCAVI

Coordinator:
ASSOCIACIÓ AEI INNOVI

The project has collected the required meteorological and soil data to ascertain the state of water resources of the plants present in the vineyards of the Penedès and Costers del Segre regions. The goal is to adapt viticultural techniques to the conditions caused by climate change. This has been possible thanks to the creation and installation of a network of sensors that track soil moisture. The data generated is compiled and analysed in a digital environment, to help farmers make proper management decisions for their crops and to predict what the plant's response will be when confronted by stressful situations.

The project includes three main areas, each of which is focused on solving a specific objective. The first has focused on being able to relate water availability data to the water stress level of the plants, which is done by reading the water potential of the leaves. The second area evaluated the results obtained from different actions related to adaptation measures implemented in response to situations of increasing water stress in order to determine the most suitable way of managing the vineyard soil and vegetation. Finally, the third area has been based on trying to optimise water management in the vineyard regarding the use of irrigation, the soil and the management of crop vegetation.

Results and conclusions

The project has managed to generate a meteorological and soil moisture monitoring network with continuous reading of data that includes 22 observation points, 18 in dryland plots in the Penedès and 4 in irrigated plots in Raïmat.

The characteristics of plots and crops were measured and the results used as reference values in the quantification of plant water stress. Analysis of the data has made it possible to define correlations between soil moisture measurements and leaf water potential, which are useful data for improving harvest planning.

One element that we have been able to study and evaluate in depth has been the effect maintaining spontaneous vegetation cover has had on the dynamics of water in the soil, as opposed to the mechanical ploughing of the vineyard. We have observed the parallel evolution between the with cover and without cover conditions until the beginning of April, and we have seen that the water potential of the soil remains much lower in the area with cover. However, from the beginning of spring until the end of July we observed that the stress level is highest in the area with cover, and then it practically evens out.

This broad monitoring shows that cover represents a very important competitive factor in years with little precipitation. Quantifying these values can help support proper management of covers in particular, which will make it possible to take advantage of the positive aspects that they bring to the fields.

Another result has been the provisions of experience and knowledge to the technicians of INCAVI, ADV and the companies participating in the project. This will allow this technology to be distributed throughout the wine sector, especially in Penedès and Costers del Segre. At the same time, the interpretation of the data -which have all been gathered on a web page that displays them graphically- aims to have future use in the generation of algorithms that allow the continuous monitoring of the planting's water status.

29

BEEFCOMPOST: optimization of the feeder cattle manure composting process

Leader:
AGROPECUÁRIA MONTGAI, SL

Other recipient members:
AGRIFOOD CORPORATION OF GUISSONA

Non-recipients:
RAMADERS DE JUNCOSA, ASSOCIATION OF CATTLE OWNERS OF ALCARRÀS, IRTA

Coordinator:
ASOPROVAC CATALUNYA

This project sought to find an alternative to the output of manure from cattle fattening farms beyond directly applying it to the fields. The production of quality compost has been evaluated in order to facilitate the export of nutrients to other, more distant agricultural areas in the form of organic fertilisers.

The initiative has made it possible to obtain estimates of manure per calf and pen in real conditions, which will enable reducing the tonnes of manure produced per pen per year in the fattening of calves and improving the quality of the fertiliser generated. At the same time, and in order to resist the effects of climate change, consideration has been given to the possibility of reducing emissions of ammonia and greenhouse gases, such as nitrous oxide or methane, thanks to the aerobic process and nitrogen capture in cattle farms.

The project was carried out in three phases. First, we made a full-scale estimate of the yearly tonnage of manure per calf per pen. Subsequently, we tried to reduce the amount of manure generated, modelling the volume of urine, working on different types of bedding and modifying the materials and quantities. In addition, we considered the assessment of the emissions and quality of the manure during storage, where work was done based on the amount, type of material and treatments applied. In the last phase, we studied the evolution of emissions and composting of the manure in real time and on location.

Results and conclusions

The results obtained in this project estimate that the average production of manure per pen per year is around 2700 kg, far from the 4000 kg stated in Decree 153/2019, on the management of fertiliser and livestock manure. The equation that estimates manure and losses determines the manure losses per calf during storage at 16%, and this is in line with the real-life data analysed, although it slightly overestimates actual production.

On a productive scale, no advantages have been observed from increasing the supply of straw, which, in addition, means an increase in expenditures. In terms of storage, increased straw supply has not led to a significant increase in the C/N ratio. The type of straw has been found to have a greater effect than the amount of straw. The use of short straw is not recommended, as it does not have positive effects on the production phase, on variables such as growth, animal welfare or cleanliness, nor in the storage phase, due to the high water retention and a possible increase in emissions.

The emissions estimates obtained have made it possible to compare and calculate the environmental impact of the farm's productive system. It has been determined that most greenhouse gas (GHG) emissions are generated during storage. Composting quickly or applying treatments such as acidification can significantly reduce this factor. The best strategy to avoid emissions is to add 0.06 l of acetic acid at 80% richness per kilogram of manure before storage. In the future, it may be possible to make solid acid compositions to facilitate application and reduce inhalation risks, but it remains to be seen whether this acidified manure would affect the bacterial growth process during composting. If this were the case, then this solution could only be applied in the field.

Increasing wetting has been observed to be essential in optimising composting. This leads to more water per turn and the addition of a structuring material such as sawdust. In addition, to reduce manure compaction, the material from the storage piles was passed through a manure spreader trailer to loosen any large blocks and further homogenise the material at the start of composting.

When implementing these strategies we observed an improvement in maintaining high temperatures, more homogeneity of the material in each pile and a lower rate of decrease in moisture content of the material in the piles with crushed material compared to those with uncrushed material with equal irrigation. As a result, the piles with more wetting, taking into account only the amount, presented higher biological activity, a fact that is reflected in a greater reduction in the mass of matter, between 0%–10% and 38%–64% with respect to the low irrigation strategy.

18

Evaluation and validation of alternatives to sodium hypochlorite in the fresh-cut industry

Leader:
AMETLLER ORIGEN OBRADORS, SL

Non-recipients:
IRTA

In recent years, the growing consumer demand for convenient, high nutritional value and safe foods has driven the increase in the consumption of fresh-cut foods that are ready to eat or cook and that maintain their nutritional properties and freshness. During the processing of these products, there is no stage that guarantees the complete elimination of all microorganisms present, and the disinfection stage is the only point at which microbiological contamination can be reduced to ensure their safety.

Currently, the most commonly used disinfectant is chlorine in the form of sodium hypochlorite. The effectiveness of this solution on plant material is limited to between one and two logarithmic reductions, even when administered in high doses. In addition, it is highly reactive, as it reacts quickly with organic matter, air and light. For this reason, water is usually hyperchlorinated at between 50 and 200 ppm, which can generate chlorine gas in the facilities and, in contact with organic matter, can lead to the production of excessive amounts of undesirable and potentially toxic by-products, such as trihalogenated compounds.

All these factors have lead to the use of this disinfectant being banned in several EU countries. There are also several initiatives researching alternatives to sodium hypochlorite, including using elements such as ozone, chlorine dioxide or peracetic acid, among others.

The main objective of this project has been to establish a disinfection procedure that guarantees consumer safety, maintains quality, extends the useful life of the product and is also more environmentally friendly.

We have focused on two work areas., The first has been to describe the current disinfection process in the beneficiary industry, with a focus on analysing the temperature difference between product and water and how this difference affects the effectiveness of the disinfectant. The other has been carrying out several trials on a leafy vegetable and a fruit with alternative disinfectants or technologies under laboratory conditions. The disinfectant has then been validated both in a pilot plant and in industry with the aim of drawing up a general action protocol.

Results and conclusions

This project has made it possible to verify the importance of adding a disinfectant to the washing water of vegetable products, which is usually recirculated. The disinfectant helps to maintain the microbiological quality of the water and prevent cross-contamination. When sodium hypochlorite is used, it is clear that this must be done carefully. The results show that it is advisable for the chlorination to be adjusted as the organic matter is consumed. This makes it easier to avoid an initial hyperchlorination that might not be sufficient and thus give rise to chlorinated derivatives that are restricted by food legislation. In the company's current conditions, both the water and the finished product met current regulations regarding food safety criteria and the presence of chlorates.

Under the conditions tested in this project, in microgreens and tomatoes, there was no evidence that the difference in temperature between the washing water and the plant material may be a factor that negatively affects disinfectant effectiveness. However, it is still recommended that a certain difference be maintained or that, at at minimum, the temperature of the water not be lower than that of the vegetables.

The project has concluded that, taking into account microbiological and quality criteria, the tested products have shown equal or lower effectiveness than hypochlorite. Nevertheless, we observed that a commercial product based on peracetic acid was the most promising alternative. Lastly, the final product presented a microbiological contamination similar to that of the current system and the washing water met current regulations. It should be noted that no pathogenic microorganisms were detected in the tests carried out.

19

Improving the quality of meat products with optical sensors integrated in the production line

Leader:
ARGAL ALIMENTACIÓN, SA

Other recipient members:
EMBOTITS SALGOT, SA, BOADAS 1880, SA, JOAQUIM ALBERTÍ, SA

Non-recipients:
IRTA, AUTONOMOUS UNIVERSITY OF BARCELONA

Coordinator:
INNOVACC

This project was based on the development and validation of online optical sensors applied to sausages and other meat products to study how this technology can be adapted to the sector. The initiative was divided into three working groups, each focused on a different area.

The first group aimed to achieve a reduction in cooking losses in the manufacture of Frankfurt sausages by means of an on-line optical sensor called EmulsioScan. The team aims to calibrate and validate the proposed optical technology to control emulsification.

The second group worked on developing a low-cost near infrared (NIR) spectroscopy system to be able to determine both food quality and food safety parameters during the curing of raw sausages based on physical and chemical parameters in the different phases of the process.

The last group aimed to optimise and improve the production process of extra quality cooked ham with a FO-NIR optical sensor. This method should allow obtaining a high-quality product free from organoleptic defects that increases cooking and cutting yields.

Results and conclusions

The project of the first group has generated and validated protocols for use of the software and for the cleaning and maintenance of the equipment. It has been confirmed that using the sensor continuously for 1.5 hours does not cause any problems, but the amount of data generated is critical. The models obtained during calibration and later validated presented biases of less than 0.3% on losses from cooking and, in some cases, even improved upon previous projects, due to the fact that they need fewer predictors.

However, in this project it has been possible to achieve a general model that would be appropriate for all formulas, regardless of whether they contain starch or not, and even for those formulas with only poultry as a raw material, which are different in terms of their optical response. Finally, a tool has been

developed to enable analysis of the great multitude of spectra that are generated on the production line, a necessary step to be able to analyse the data generated both continuously and *in situ*.

The second group has developed a method for predicting physicochemical parameters such as fat content, moisture and water activity in different matrices of meat products through the use of a low-cost pocket NIR system, which has made it possible to obtain calibration models with errors of less than 1%. Specifically, the moisture and fat models achieved are applicable to the mass of meat mixture coming out of the mixing machine and combined with pagès sausage and extra quality chorizo. The models obtained for fuet determine water activity and moisture inside the product. Models have also been obtained to predict the parameters under study that appear in unmixed mince and on the surface of fuet, although the errors increase slightly.

Thanks to all the results obtained from the project, it is considered that the NIR system used has the potential to become a useful tool in industrial environments to determine the studied parameters of quality control and food safety.

The third team successfully implemented the QMEAT inspection system in La Selva's cooked ham production line. The measurement modules, pH and FO-NIR, have proven to work well throughout the testing period, both in functional terms and in terms of accuracy and repeatability. Industrial validation tests have confirmed the sensitivity of the QMEAT system to discriminate between different categories of meat. In particular, defects, in many cases serious, have been found within the group of pale hams. The implementation of the QMEAT system in production has made it possible to establish different product qualities according to objective parameters.

The FO-NIR system ensured a very high percentage of identification of exudative hams. On the other hand, the triage system based on the Japanese colour scale had very important limitations when applied to the whole piece, although it is considered that it can become a valid system in the categorisation of boneless ham on site. In contrast, the FO-NIR system proved to be reliable and robust for the categorisation of ham upon receipt. In addition, a fundamental advantage of this system has been the fact that it provides a quantitative, objective, repeatable and operator-independent index. According to this quantitative parameter, criteria could be established to allocate each piece to the production of a specific quality of product that also ensures a consistent quality in the final product.

2

Automatic classification of peaches and nectarines according ripeness stages using non-destructive technology

Leader:
BARÓ E HIJOS, SL

Other recipient members:
FRUITS DE PONENT, SCCL

Coordinator:
IRTA

The aim of this project was to obtain a tool that allows fruit to be classified non-destructively according to ripeness using an NIR system integrated in the production line. During the project, the performance of NIR models was evaluated in relation to different instrumental parameters of the fruit such as firmness, sugars, acidity and chlorophyll according to different types of samples, such as the species, type or variety.

The new system, already implemented in Baró e Hijos and Fruits de Ponent, should facilitate decisions on the best way to direct the fruit, so that the ripest pieces are designated for short-haul markets and the least ripe to long-haul markets.

With this technology it should also be possible to identify the parameters with the highest potential for the classification of peaches on an industrial scale.

Results and conclusions

When measuring fruit quality parameters, transmittance NIR spectroscopy has been found to be more efficient than reflectance NIR spectroscopy. When using transmittance technology, the light interacts by passing entirely through the fruit, which allows for more accurate results of the state of the fruit as a whole. On the other hand, in reflectance measurements, the light interacts only with the surface of the fruit.

Of the instrumental quality and ripening parameters analysed, such as firmness, acidity, degrees Brix and chlorophyll index, it is the last two of these that have shown the most robust NIR calibration models for industrial use. Measuring these two parameters provides information from two aspects: the chlorophyll index makes it possible to know the ripeness of the fruit, and the degrees Brix show organoleptic quality. In general, fruits with higher values tend to deteriorate earlier and therefore have lower keeping potential.

The performance of the NIR calibration models varied de-

pending on their specificity. In general, panoramic models showed lower performances than local or specific models. However, the chlorophyll index was less sensitive to the type of sampling than degrees Brix. It would be feasible to use global chlorophyll models for different types of fruit. For degrees Brix, specific models need to be developed according to variety and seasonality. The chlorophyll index values allows separating fruit into two categories: ripe and unripe. Interpretation of the results and tolerance thresholds may vary slightly depending on the variety or type of fruit. In general, for the same ripeness category, round peach fruits recorded higher chlorophyll values than nectarines and doughnut peaches.

In summary, the chlorophyll absorbency index emerges as the best candidate for non-destructively determining the ripeness status of peaches on the production line, with significant advantages over other traditional parameters such as firmness. This, in turn, facilitates its implementation in industry.

The adoption of this parameter by the entire production line can bring several advantages and would speed up its implementation in the classification lanes. But more efforts are still required to establish tolerance thresholds due to the broad genetic variability.

Before NIR spectroscopy can be employed industrially, robust calibration models must be developed to ensure accuracy of the prediction results. Several factors can influence the accuracy and reproducibility of the reference methods, such as the sampling method used to collect representative samples, the provenance and size of the fruits, the spectrum pre-processing methods, the quantitative or qualitative modelling methods, and others.

Panoramic or local/specific models can be generated depending on the data used in developing the calibration. It should be noted that in order to achieve a robust global model, this model must be able to withstand seasonal, geographic and genetic variations. Peaches are a fruit with high genetic heterogeneity. Added to this is local and seasonal variability over different years and origins.

Processing plants must remember that it is essential to identify the variables that can affect the spectra and that these variables must be taken into account when determining a calibration model. When implementing NIR systems in the production line within processing plants, the cost of integration and communication between the NIR system and the quality control system for real-time industrial applications should also be considered.

20

VALACTICAT: pilot project for waste valorization whey in Catalan food industries

Leader:
BETARA, SL

Other recipient members:
AMETLLER ORIGEN OBRADORS, SL

Non-recipients:
EURECAT FOUNDATION

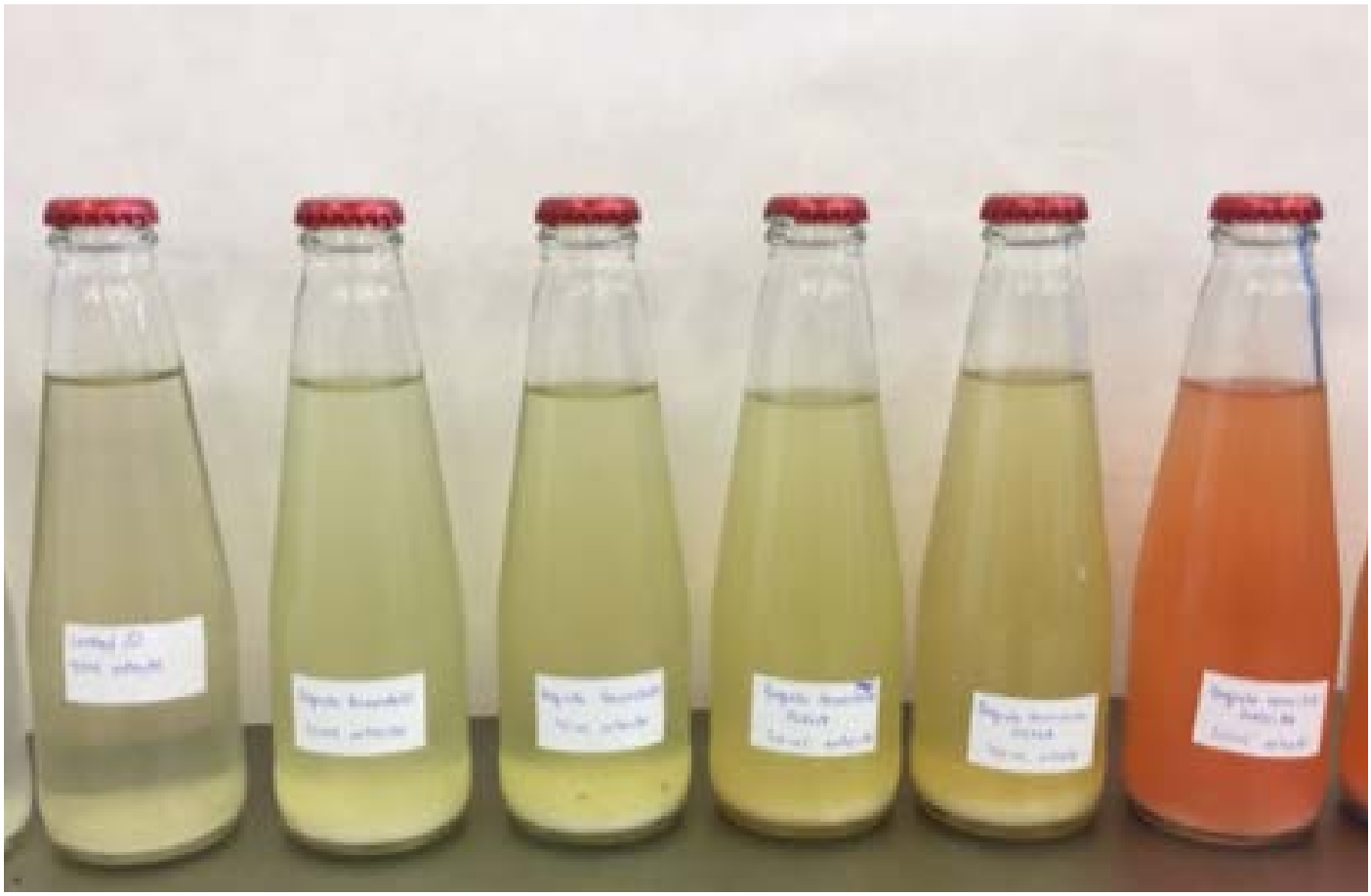
Coordinator:
ASSOCIATION OF THE FOODSERVICE CLUSTER OF CATALONIA

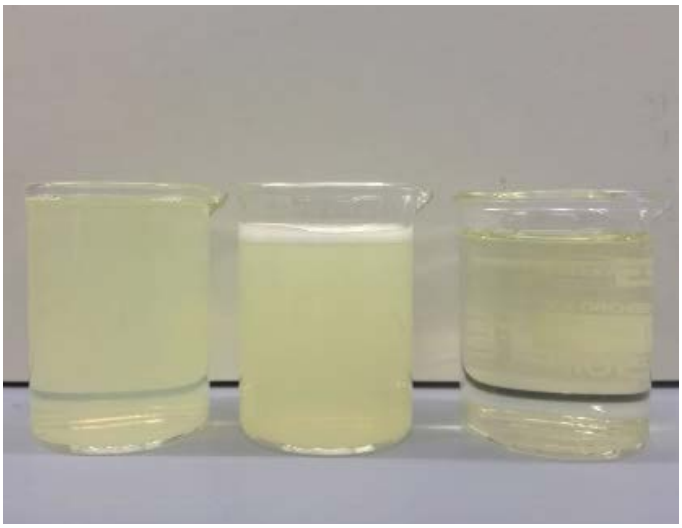
Almost 85% of the milk used to make cheese is rejected as whey or curd, a liquid rich in salts and lactose that contains 20% of the milk proteins. Repurposing this whey as a by-product in the food industry is of great interest to the companies in the sector, since, on the one hand, treating the whey as waste brings with it an environmental impact, on top of the additional costs.On the other hand, repurposing opens the door to the possibility of introducing new products to the market.

The project has proposed different concentration processes for repurposing whey, while at the same time it has made it possible to study the reincorporation of whey fractions in food matrices. It has also intended to develop new products using fermentation as a unitary operation in order to develop a new range of products.

To achieve the general goal of the project, we started by characterising the nutritional composition of the wheys of different origins that are generated in the industries of the consortium companies. Subsequently, we studied their characteristics and examined the nutritional, structural and sensory properties of the fractions obtained from the whey fractionation processes. Finally, we determined how to integrate these fractions in current commercialised food products or in the generation of new innovative products and evaluated the technical and economic feasibility on an industrial scale.

Implementation of these results on the part of participating companies has represented a firm commitment to the principles of circular economy, promoting efficient management and competitiveness and diversifying activities in an environmentally sustainable manner.





Results and conclusions

The project has allowed Betara and Casa Ametller Origen Obradors to find a potential system to repurpose whey to reduce processing costs and simplify the treatment programme, while at the same time embracing the latest technological innovations. In keeping with the characterisation performed, we have been able to identify that the whey mainly consists of sugars, primarily lactose and galactose. A relatively high percentage of fat has been observed in the processing with the different proposed fractionation systems, such as reverse osmosis or the use of membranes. Therefore, skimming has been considered as the first unitary operation for repurposing whey.

Concentration processes such as ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO) have also been studied to obtain different fractions.

Due to its high cut-off value, the membrane selected by UF does not achieve the separation of sugars and ions between impregnate and concentrate. On the other hand, this technology is ideal for separating proteins. That makes it possible to produce a concentrate with the same characteristics as the initial whey in terms of sugars and ion concentrations and with a higher concentration of proteins, a variable which depends on the amount of water recovered.

On the other hand, NF allows a combination of volume reduction with partial demineralisation in a single processing step. However, there was high rejection of multivalent ions due to the cut-off value of the selected membrane. At the same time, there was a very high rejection of sugars such as lactose, while small traces of galactose were found in the impregnate.

The applicability of skimmed whey was studied, as well as the different fractions obtained by concentration processes in various food matrices such as dairy desserts. The possibility of using skimmed and pasteurised whey and concentrated whey without impacting the technological and sensory attributes is highlighted in these applications. It has also been possible to develop food products using fermentation as a unitary operation, which opens the door to the development of a new range of products.

Finally, we performed a life cycle analysis, a method that allows calculating the environmental impacts of a product taking into account its entire life cycle, and the application of which has been defined in standards ISO 14040 and ISO 14044. This analysis has made it possible to verify that the repurposing of whey is beneficial from an environmental and economic point of view. However, the environmental and economic performance depends on the product being replaced or deployed. It should be noted that the study did not consider the use of the fat that is also generated as a by-product when repurposing whey. Should it also be repurposed, the environmental and economic performance would be even more favourable.

21

Innovating with flavoured wines, spirits and liqueurs in wine cooperatives: a prime opportunity for opening and strengthening new market segments

Leader:
CEVIPE, SCCL

Other recipient members:
AGRÍCOLA FALSET-MARÇÀ I SC AFALMA, SCCL

Non-recipients:
VITEC

Coordinator:
FEDERATION OF AGRICULTURAL COOPERATIVES OF CATALONIA

This project explored the diversification of the market for Catalan wine products through the recovery of historical and traditional recipes. The ultimate objective was to produce a new range of flavoured wines, distillates and unique liqueurs from base wines made with the main varieties present in Penedès and Priorat. Those varieties use aromatic herbs from both territories to obtain a totally unique, high-quality product. This was all to be done while maximising the particular characteristics of the wine-growing territories represented by the operational group's partner cooperatives.

Based on the recovery of historical recipes for distillates, flavoured wines, vermouths, ratafias and liqueurs from the two aforementioned regions, we wanted to determine which varieties are viable based on their availability and ingredient availability. By optimising the preparation system for the recipes with the most representative and territorial individuality, it will be possible to add value to the new products developed in coordination with the trade and tourism sectors of these regions.

The commercialisation of table wine and wine by-products such as lees and pressing residues has traditionally led to products of low added value. With this proposal they can acquire a high added value, also partly thanks to the fact that this is a local product that promotes a circular economy in the area. In short, this project will be able to generate new lines of business for participating wineries.

Results and conclusions

The cooperation between the members of the group has made it possible to study the process and the variables involved in the production of spirits and flavoured drinks, which has led to obtaining knowledge that has been applied in the industrial production of new wine products.

The suitability of the wine varieties specific to each territory to be used as a basis for the different types of product was studied as part of the project, and the most suitable combinations of these varieties were selected to produce the distillates and flavoured wines. The indigenous white varieties of each region were suitable as a base for flavoured wines, while some of the red varieties were suitable for obtaining wine alcohol.

We have also drawn up a list of herbs and botanicals that are characteristic of Catalonia and suitable for the preparation of the products under study and which were also used for the preparation of new flavoured wines. Subsequently, a maceration protocol adapted to each preparation was established by combining the results observed in relation to variables such as time, tank shape, the concentration of botanicals, alcohol content and the degree of agitation.

Different filtering conditions were studied in order to correlate the microbiological stability of the wine to its sensory characteristics and to be able to use this information in the cost-benefit assessment of the oenological itinerary to be followed. No significant differences in either the sensory or the microbiological aspects could be detected between the products obtained from the different filtering processes studied.

With the results achieved, the wineries have been able to choose the most suitable moment to stabilise the product within the production process. The results have been completely satisfactory both for the stabilisation of base wines and for the stabilisation of the finished products. They have also made it possible to establish a specific production itinerary for each product and producer.

4

Inking in peaches. Causes and Solutions

Leader:
COOPERATIVA AGROPECUÀRIA DE SOSES, SCCL

Non-recipients:
IRTA

Inking is the name for a physical problem that frequently manifests in stone fruit, especially peaches. It consists of the appearance of dark coloured spots on the surface of the fruit, often due to bumps and rubbing during harvesting and transport, and which affects only the epidermis. It is an aesthetic defect that makes the fruits less valuable for commercialisation in the fresh market.

Its incidence is variable depending on the years, the varieties, the plots and the producers, but in some cases it can be very high, up to 80%. This fact can represent a significant economic loss for the producer, since it substantiallu reduces the profitability of the operation. For these reasons, there is interest in gaining further knowledge of this issue.

The aim of the project was to identify the causes of peach inking and to study the specific conditions of peach producing areas in Catalonia. The initiative will make it possible to propose strategies to eliminate or reduce the incidence of inking.

Results and conclusions

During the three growing years that the project lasted, we have evaluated for at least one year each of the factors that enhances the appearance of inking in peach varieties grown in commercial plots. The results have shown that there is great variability in the manifestation of this issue according to peach varieties. *Royal Summer* is a very sensitive variety, compared to *Ryan Sun* and *Summer Rich*, which are less susceptible. On the other hand, the presence of inking in the *Sweet Dream* variety was different depending on the year of evaluation.

Of the different harvesting methods used -which are boxes, sacks and buckets- no conclusive results were found to reduce the expression of inking. However, we have empirically proven that any measure towards reducing bumps and rubbing during harvest and transport of the fruit will improve the incidence of inking.

Harvesting the fruit at different states of ripeness has not given clear results, although of the three varieties evaluated, in this case *Sweet Regal*, *Flatstar* and *Sweet Henry*, it was the last of these that showed differences according to the state of ripeness. Fruit harvested during commercial harvest presented 20% less inking than that harvested 3–4 days after commercial harvest.

The irrigation and fertilisation strategies applied during the course of this project on different varieties of peach have not provided clear results regarding which dose of irrigation and fertilisation is the best to reduce or mitigate the expression of inking. However, we have observed that doubling the usual irrigation dose can increase the appearance of spots on fruits by 10%.

Although the results are not wholly conclusive, the project has provided several practical recommendations that should help reduce inking in peaches. It is essential to know the susceptibility of the variety to this phenomenon before planting, as well as reducing, as much as possible, the number of intermediaries used to pour the fruit into boxes. If the fruit is harvested and poured with care when at an adequate and homogeneous state of ripeness, the incidence of inking is reduced. Lastly, controlling and monitoring irrigation throughout the fruit ripening process has also shown satisfactory results, so it is advisable to avoid high doses of irrigation in the last month before harvesting.

3

Innovation in ornamental plants: from cultivation to the end customer with blockchain technology

Leader:
CORMA, SCCL

Non-recipients:
CULTIUS TIANA, SAT, FEDERACIÓ DE COOPERATIVES AGRÀRIES DE CATALUNYA, FUNDACIÓ EURECAT, CULTIUS GAXAS, SL

Implementation of a decentralised platform has been proposed to provide maximum traceability of the plants distributed from the CORMA cooperative production until they reach the final customer, including any raw materials used. The project also extended to the integration of this platform in the information and communications systems currently used by the cooperative.

This new platform is based on blockchain technology, a type of decentralised data structure where information is stored in blocks chained together on a timeline. These blocks are attached to the chain after a consensus process between validating nodes in the network, which ensures that the information contained in the blockchain can be considered irrefutable. Process optimisation through this innovation will make it possible to enhance the productivity of ornamental plant operations.

The objective was to improve resource management by reducing errors, inaccuracies and malfunctions in all production processes, which generate losses of both material resources (especially product) and energy, while also causing considerable logistical incidents.

The proposal aims to improve the economic results of co-op members and agricultural producers, as well as to allow them to restructure and modernise. Through increased efficiency and reduced market penalties, we intend to see these companies become certified in the ornamental plant market.

Results and conclusions

The pilot tests saw the creation of individual IDs for each pot with a serial number that allows individually tracing each plant. A sustainable crop certification for production was created, and a reception by individualised image of the product with respect to the logistics phases was also created. This ID contains various elements such as tokens, roadmaps or delivery dates, depending on the type.

The results of the pilot project have shown that in order to be able to apply blockchain technology to a wider range of products and obtain traceability for each pot without impacting process management, it is necessary to implement RFID technology, as this would allow massive reading of the product in reception points, sending and cultivation.

Finally, we detected that despite blockchain technology still not being very well known in the sector, it has managed to generate interest among the more technologically inclined customers through marketing campaigns and product presentations at fairs.

22

Effective communication of vertical integration as a stimulus to the consumption of local primary products *(think-local)*

Leader:
CORPORACIÓ ALIMENTÀRIA GUISSONA, SA

Other recipient members:
ANDREU ALIMENTACIÓ, SL

Non-recipients:
PIMEC-AGROALIMENTÀRIA, INTEREMPRESAS MEDIA, SLU

Coordinator:
IRTA

Control and traceability of an entire production process, from origin to the end consumer, constitutes a valuable alternative for companies in the primary sector to address the fragility of the agricultural sector. This factor is known as vertical integration, and together with cooperativism it helps producers and companies to position themselves in different markets and be more competitive.

With the work carried out within this operational group, we have approached the study of consumer behaviour from a multidisciplinary approach, focused on both individual and unconscious cognitive biases. In this way, the intention is to induce all possible voluntary changes in the short term, especially in the population under 30 years of age.

The result of this task should allow companies, as has been the case of BonÀrea, a division of the Guissona Food Corporation (CAGSA), to modify their image and transmit the values of vertical integration to the consumer, a fact that will favour the consumption of local products and will add value to the origin of the product and to primary production throughout the company's locations.

In order to identify the opportunities for improvement in the shopping space, it was necessary to determine how the brand and its values were perceived. The operational group has also carried out an in-depth analysis on how to improve the shopping experience in its stores and how to effectively convey the values associated with vertical integration. This fact has resulted in the implementation of improvement actions in pilot establishments and in industrial tourism activities that have permitted the evaluation of the consumer response.

Results and conclusions

Throughout the project, several proposals for improvement in the effective transmission of the values of vertical integration through physical and online shopping establishments were identified. In physical establishments, it is recommended to use colours reminiscent of nature such as brown, green or beige, as well as the presence of plants in stores that reinforce the link with nature. It is also intended to give the establishments an appearance like that of village shops, with the use of materials such as wicker or wood on floors, shelves, boxes and displays, as well as blackboards to write offers, prices or other information in chalk.

In contrast, elements such as plastic must be reduced as much as possible and must be replaced by packaging with less environmental impact, such as cotton trays and cardboard nets. Stone, brick and wood will be incorporated into the walls for a more rustic appearance, on which it is recommended to place photographs of the countryside with farmers and slogans emphasising the lack of middlemen.

On the online shopping website, the emphasis should be on new items, an aspect highly valued by millennials, The number of product categories presented on the home page should also be reduced, since there is no consistent proportion between food categories and other categories or subgroups. Although the simplicity of the website helps convey the message of "no middlemen", the participants also believe that it is a good thing to use colours that remind the viewer of nature and images that depict the countryside and relate to the area where the products come from.

As a general assessment, a significant positive change in brand perception has been observed after applying these measures. On the other hand, younger consumers are the most aware of sustainability, animal welfare and social responsibility. Therefore, the company's strategies aimed at this specific segment need to align with these values. The combination of classic techniques from the study of consumer behaviour with neuroscience measurements has made it possible to more effectively research and identify how to improve the overall shopping experience.

5

PREDIVÍ: wine harvest prediction model using *big data*

Leader:
COVIDES, SCCL

Other recipient members:
VITALPE, SAT, UNIÓ FRUITS, SCCL

Non-recipients:
INCAVI, EURECAT FOUNDATION

Coordinator:
ASSOCIACIÓ AEI INNOVI

The ever-increasing variability in the volume and quality of wine production means increasingly high investment of resources and dedication of technical teams to obtain vintage predictions. Currently, technical teams use multiple systems such as sampling, ripeness controls or measurements, but the results that these systems provide can be made much more reliable. The large number of variables that affect both the quality and quantity of operations makes it very complex to achieve reliable predictions with traditional approaches.

The main objective of this operational group was to provide organisations and actors in the wine sector with tools to support their decision-making, which in turn should allow them to obtain information on harvest predictions in advance. The areas the project focused on were production volume per plot, the classification of the qualitative potential of the plots and the quality parameters of the production, such as grade, acidity and pH

The project is based on the use of big data and machine learning technologies. In order to achieve our objective we used information such as production log history, plots, ripening controls and sampling that were available to the companies and organisations participating in the project. These data, together with the variables obtained during the campaign such as meteorology and satellite images, allowed us to carry out our predictions.

Results and conclusions

The project has made it possible to define and validate the set of variables necessary to create each prediction model. The final model is fed by data from the current plot, historical yields and previous harvests, satellite imagery and, finally, current and historical hyper-localised weather data. A prediction model was created based on the above variables that provides results with errors of less than 10% in quantity.

The necessary technology has been optimally developed. The resulting predictive model for harvest quantity and quality has a similar margin of error to current methods, but acts much more efficiently. It has thus been possible to automate all the data transmission processes between the existing information systems, which are the ones currently being used by the beneficiary companies, and the new prediction models carried out by this initiative.

A platform has been created to display the results of the prediction models based on graphics and maps that represent geolocated variables. In addition, we have verified that the margin of error is substantially reduced if the data corresponding to a single manual sampling –of which eight can be done per plot in a conventional campaign– is added to the historical data and the data obtained automatically by the system.

The system is learning continuously, so it is expected that the margin of error between prediction and reality to become smaller in each campaign. End users considered the level of automation and results display systems to be optimal.

The resulting model, therefore, has achieved a considerable reduction in costs connected to plot sampling and incorporates a powerful learning capacity that ensures the reduction of error in future campaigns.

6

ALMON: keys to improve the management of brown rot in almond trees

Leader:
CRISOLAR NUTS, SL

Other recipient members:
BORGES AGRICULTURAL & INDUSTRIAL NUTS, SA, UNIÓ NUTS, SCCL, OCEAN ALMOND, SL, FRUITS SECS LES GARRIGUES, SCCL

Coordinator:
IRTA

In Catalonia, almond cultivation is typical of the coastal regions of Tarragona and the plains of Lleida, mainly in non-irrigated land. Traditionally, it had been limited to marginal areas because it is one of the few productive options in semi-arid lands and low-quality soils. However, new varieties and irrigated almond cultivation techniques have been promoted based on IRTA studies, such as new productive models or new irrigation strategies.

In this context of new agronomic practices and almond cultivation systems, we must pay attention to diseases that can limit the potential development and consolidation of new irrigated plots, such as the disease caused by the fungus *Monilinia spp.*

This operational group has studied the epidemiology of moniliosis (brown rot) in almonds in the production area of the Ebro valley to identify the causal agent, monitor its presence in infected plant material and evaluate its sensitivity to the main fungicidal products used in the intensive management of this crop. In this project we have also determined the importance of the damage caused by *Monilinia spp.* in almond and any contributing factors.

Results and conclusions

The studies to identify the sources of primary inoculum have shown that, on the farms evaluated, the soil under trees does not present *Monilinia spp.* spores, and that the main source of spores are the mummy nuts found on the ground and especially on the tree. Wood cankers with symptoms of brown rot also showed spores of this fungus. Therefore, we concluded that it is advisable to remove this type of plant material in its entirety during the autumn-winter period in order to minimise the primary source material for infection for the following year.

As a source of secondary inoculum, we determined *Monilinia spp.* as the cause of the points of infection with symptoms of the disease. In addition, its incidence was highly correlated with weather conditions, especially rain. *Monilinia* spp. spores were identified throughout the phenological cycle of the crop, in flowers and during fruit development as well as in cankers.

On the other hand, environmentally, the presence of *Monilinia* spp. in the evaluated fields could be considered insignificant and not decisive as a source of secondary inoculum. Therefore, treatments to control it should be applied when there is risk of infection.

All the strains isolated in these fields were identified as *Monilinia laxa*, and differences were observed between the isolates regarding their ability to infect flowers and fruits.

We detected that the number of affected inflorescences and shoots is highly affected by climatic conditions, and the 2020 growing season was the one with the highest incidence of disease.

Finally, the monitoring of the disease in Catalonia, but also in other almond-growing areas of Spain, has shown that the main species causing this pathology is *Monilinia laxa*. We also concluded that with the isolates obtained and evaluated, resistance to the most common fungicides used in the intensive management of this crop, such as fludioxinil, fenbuconazole, pyraclostrobin, tebuconazole and difenoconazole, was not detected.

8

Control of *Myzus cerasi* in cherry trees through functional biodiversity (use of ecosystem services)

Leader:
EXPLOTACIONES AGRARIAS LOS MASOS, SL

Other recipient members:
SAN DOMINEC AGRICULTURAL COOPERATIVE

Non-recipients:
IRTA, ZUMOS CATALANOARAGONESES, SA, ASSOCIACIÓ EMPRESARIAL DE FRUITA DE CATALUNYA (AFRUCAT)

Coordinator:
EXPLOTACIONES AGRARIAS LOS MASOS, SL

Until now, the only effective method of controlling certain pests in modern intensive agriculture has been based on the generic and indiscriminate use of insecticides. The simultaneous application of different active ingredients is often necessary to achieve effective control of a pest.

The vast majority of insecticides and their residues persist for more than 21 days. Therefore, their application in the fruit ripening period, which usually coincides with the period of maximum impact of insect damage, can leave pesticide residues in fruit. This causes a loss of quality and foregoing stricter markets with higher selling prices. It therefore becomes necessary to act against the presence of traces of synthetic insecticide residues, which is currently one of the main problems affecting the fruit sector when it comes to marketing.

The project by this operational group proposes to reduce the use of synthetic pesticides in cherry cultivation by replacing pesticides with pest control based on promoting functional biodiversity. In agronomy, functional biodiversity means all insects that act as auxiliary fauna or natural enemies capable of exerting control over one or more pest insects. Functional biodiversity could therefore be enhanced by planting auxiliary crops such as cover crops, which would at the same time generate a benefit to human beings, which is called an ecosystem service.

We started by determining the capacity and feasibility of implementing a cover crop system in cherry cultivation. After quantifying its annual and year-to-year evolution in relation to the auxiliary fauna, we assessed its capacity as a main or combined method of control of *Myzus cerasi* in cherry cultivation.

Finally, we evaluated the health and quality of the harvest, as well as the post-harvest evolution without applying plant protection treatments. To take into account the economic and environmental impact of this new method, we have had to analyse soil conservation, the ecological footprint and water retention and compare them to those of usual pest management.

To facilitate its application both in cherry cultivation and in other crops with similar problems, the results of the pilot project were designed so that they could be shared with the sector and the territory.

Results and conclusions

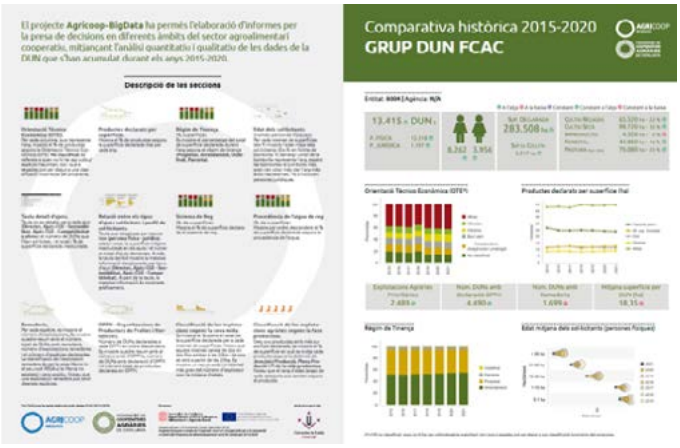
The cover crops became established relatively satisfactorily, but flowering was happened to a degree lower than expected. Further work is needed to develop a mixture and, above all, a more suitable management that perfectly adapts to local conditions.

Overall, we observed that cover crops increase the abundance of natural enemies and pollinators in cherry farms. This fact has not lead to any extra costs for additional handling and has had no negative effects on the harvest or the quality of the cherries.

The auxiliary cover crops must be maintained in good condition over time, as the establishment of a new balance in the agricultural agro-ecosystem is a slow process that requires patience and persistence, and it may take several years to achieve a pest control that is sufficiently effective to be able to dispense with insecticide treatments.

7

AGRICOOP BIGDATA: intelligent processing of useful data in the productive processes of cooperatives



Leader:
FEDERATION OF AGRICULTURAL COOPERATIVES OF CATALONIA

Non-recipients:
UNIVERSITAT DE LLEIDA

The work of agricultural cooperative members generates a large amount of data every year that is not transformed into useful information for the cooperatives. The Single Agricultural Declaration (DUN, by its Catalan initials) is an annual declaration that allows for systematically updating the farms of all producers in Catalonia, including information from different public administration records or from grant applications. This project aims to allow data from the DUNs to be combined for the first time with data from other sources and transformed into information that can be used. The goal is for each cooperative to be able to obtain a set of information that is individually relevant to them and can thus allow them to draw conclusions from that information.

The objective of this operational group has been to generate intelligent, comparative reports and future forecasts by means of advanced analysis of the annual data generated from the DUNs through machine learning and knowledge discovery techniques, with the goal of aiding in the decision-making process in the cooperative sector. We performed the design, definition and validation of a cloud platform that integrates this data, making it possible to generate these reports, along with other public databases that complement the information from the reports. This whole process is done in a non-relational, big data environment that is useful for strategic decision making.

The project started by analysing the data from years 2015–2021 obtained from the DUNs of the members of the agricultural cooperatives in the DUN-CGE-FCAC Group. Summary reports were prepared at different levels, such as growing year data, comparisons with the sector, geographic environment or historical comparisons, with the aim of being able to display the data in a simple and very visual format to facilitate the strategic work of the cooperatives and the FCAC. The managers of these entities are thus given tools and have more information available to be able to generate new services and business models.

Results and conclusions

The main result obtained in this project is to have sucessfully created the intelligent expert system called Agricoop-BigData, which allows a quantitative and qualitative analysis of historical data, as well as making predictions of future trends in different scenarios.

The Agricoop-BigData system, based on advanced mathematical and statistical knowledge and techniques for handling large volumes of data, provides valuable information for decision-making in different areas of the cooperative agri-food sector, such as individual responses for each member, strategic information for each cooperative and, at the last level, information for the sectoral organisation that represents them.

The system analyses, systematises and organises the information and is able to generate synthetic reports that, with supervision by skilled human resources, provide this strategic information. The entire system converges on the generation of high-value reports that allow the implementation of new services.

The final result has made it possible to obtain annual files for each cooperative of the DUN-FCAC Group, detailing all the growing year information and presenting comparative files between the cooperative and the DUN-FCAC Group and comparisons on the scale of FCAC-Catalunya.

Finally, the project is expected to allow the Catalan agricultural cooperatives and their members to make a qualitative leap, since the use of this information will enable them to make better decisions both as individual agricultural operations and as a cooperative. This step should also allow a greater integration of cooperatives in the field of research and to strengthen relations with one of the main universities in the country in the agri-food field, a fact that ensures collaboration in future projects.

On the part of the FCAC, it is also innovative to use real data to become familiar with the different sectors represented in order to be able to negotiate new agricultural policies with the public administration and to be able to obtain sectoral benefits, depending on the data processed.

23

Innovative systems to objectively classify meat products or meat preparations

Leader:
BUSINESS FEDERATION OF MEAT AND MEAT INDUSTRIES

Other recipient members:
JOAQUIM ALBERTÍ, SA, COOPECARN GIRONA, SLU, NOEL ALIMENTARIA, SAU, ROLER ESPAÑA, SLU

Non-recipients:
IRTA

Coordinator:
INNOVACC

The meat sector has always had the challenge of objectively distinguishing between meat preparations and meat products. The classification of a meat derivative into one of these two categories determines the additives that can be used.

According to current regulations, the key to classification as a meat preparation or a meat product is the degree of transformation undergone by the meat derivative. If the final product shows alterations in the internal structure of the muscle fibres or if the surface of the cut does not retain the characteristics of fresh meat, the product loses the category of meat preparation. But the usual methodologies based on histology have so far not been sufficiently robust to be able to establish a clear differentiation between the two types of products.

This project has sought to implement an objective methodology based on currently available analytical procedures that supports the unequivocal differentiation between meat preparations and meat products. This analysis has taken into account several parameters of the meat derivative production process, depending on the degree of transformation and alteration of the internal structure of the muscle fibres experienced during the derivative production process.

This could lead to development of a tool to facilitate decision-making and to carry out the technological adaptation of meat derivatives and to classify them according to current legislation.

Results and conclusions

Among the main results of the study, we can highlight the proposal of a classification system using an analytical method that is simpler and faster than the methods using histological and protein solubility analysis. This method was based on the evaluation of near infrared (NIR) spectra of a meat derivative during the control phase and after high pressure processing, which relates changes in the spectra with the degree of preservation of the characteristics of fresh meat.

This analytical method has allowed the meat derivative to be classified as a meat preparation or a meat product according to changes in the NIR spectra. Changes in the NIR spectra are greater when the meat derivative presents more characteristics of fresh meat, due to the greater effect of high pressure on protein structure. On the other hand, change in the NIR spectra are smaller when the meat derivative presents less of the characteristics of fresh meat. This is associated with the fact that the proteins are already denatured and gelled by the process of making the meat derivative, and therefore high pressure has less of an effect on the protein structure.

A decision tree was designed to unambiguously classify meat derivatives in meat preparations or meat products using the classification model of meat derivatives obtained according to measurement of the NIR spectra. A second decision tree was also designed to adapt and modify the production process of the meat derivative, so that it becomes a meat product depending on key process parameters.

As soon as a clear and unequivocal classification of meat derivatives is achieved, the processing company will be able to monitor the key parameters of the derivative and ensure that they remain within the previously defined ranges used for classification. With this proposal, further classification analyses would not be required as long as the key parameters of the meat derivative remain within the range defined in the validation process.

If the meat derivative is classified as a meat preparation when it leaves the company -that is, right at the beginning of its useful life- it must be considered as such regardless of whether it can become a product during its useful life. On the other hand, if the meat derivative is classified as a meat product when leaving the company, it can no longer become a meat preparation.

The final objective of the implementation and validation of this new analytical methodology has been proposed as a reference tool to be used by the competent authority and companies, which should allow the classification of commercial meat derivatives that cause reasonable doubts as to their classification.

16

Innovations in products, processes and marketing to introduce to the Catalan market local woods with special characteristics of greater added value

Leader:
FORESTAL DE CATALUNYA, SCCL

Other recipient members:
AGRUPACIÓ FORESTAL DEL MONTNEGRE I EL CORREDOR, SL

Non-recipients:
FORESTRY SCIENCE AND TECHNOLOGY CENTRE OF CATALONIA, MADERERA GERUNDENSE, SA, FOREST BIOENGINEERING SOLUTIONS, SA (FBS)

Coordinator:
FORESTAL DE CATALUNYA, SCCL

This project arose from the need to introduce to the Catalan market local woods with special, unique, local characteristics and based on sustainable forest management, and to make them available to end consumers through a virtual platform.

Those interested in promoting the initiative have mainly been members of the Forestal de Catalunya cooperative and the Forestry Association of Montnegre and Corredor.

In this sense, the project has aimed to introduce a new product that is different from the format of standard dimension wood planks of large department stores. The pre-processing of this product must be as minimal as possible, and it must be dried in ideal conditions to guarantee optimal technological quality and in *boules* format, as in the French model.

Traditionally, this type of wood was mainly used in the packaging and bioenergy sectors. Thanks to this project, the wood in *boule* format will be able to be introduced to the retail market, where the main segment of the market are wood craftsmen, cabinet makers, carpenters, decorators, architects and surveyors. This will improve the economic results of forestry operations and offer forest owners the possibility to opt for a wider range of products with more added value when selling wood.

Part of the project's intention has also been to improve the competitiveness of the two groups of forest producers that have collaborated with the operational group, which brings together forest producers and groups of owners, who will see their product reoriented towards new local markets with short distribution circuits.

Results and conclusions

The end result has led to the creation of the SingularWood business initiative, which aims to facilitate commercialisation and add value to the wood from our forests that has special and unique characteristics. All the products it sells are unique pieces, a fact that provides much added value.

We created a virtual platform with the domain www.singularwood.cat, where all the *boules* are available to end customers. On the same platform there is a descriptive card for each product detailing all the necessary information. In this way, any craftsman interested in using the *boules* will be able to determine the suitability of each product to creating the unique pieces they have envisioned and designed.

By carrying out this operational group, we have been able to launch an initiative that brings added value to logs that have unique characteristics and that allow, after going through a minimum pre-treatment process and with a guarantee of traceability, artisans to make their unique creations using a local product that had not yet been used in this field.

17

Increase in polyphenols in extra virgin olive oils produced in Terres de Lleida

Leader:
COOPERATIVA LA GRANADELLA I SECCIÓ DE CRÈDIT SANT ANTONI ABAD, SCCL

Other recipient members:
COOPERATIVA L'OLIVERA, SCCL, SIMBIONATUR, SL

Non-recipients:
UNIVERSITY OF LLEIDA, IRTA

Coordinator:
COOPERATIVA LA GRANADELLA I SECCIÓ DE CRÈDIT SANT ANTONI ABAD, SCCL

One of the opportunities available in the olive oil sector is its capacity to adapt to changes in consumer demand, such as the demand for increasingly sophisticated products, including premium, organic oils,oils with a guarantee of origin or with health declarations compliant with European regulations. Health claims grant permission to use information related to the prevention of the risk of contracting diseases in food labelling and advertising. When the oil is of good quality, the use of this authorised health claim allows producers to differentiate their product and generate an opportunity in the sector.

This project sought to establish procedures and develop techniques and methodologies to obtain extra virgin olive oil of the arbequina variety with a higher concentration of polyphenols. The study was carried out in three different mills over two campaigns and worked on the different parts of the olive production process, such as work in the field, pressing, storage and conservation.

We thus hope to take better advantage of the health vector as an added value in olive oil production.

Results and conclusions

The project determined that, with a suitable extraction, filtration and conservation process it is possible to produce oils of the arbequina variety with a sufficient amount of polyphenols to make use of the health claim. The most important elements to be taken into account are the settling process, the temperature to which the paste is subjected, the amount of water added to the equipment and regulation. We also observed in several trials that the use of an accessory that helps to distribute water in a more controlled manner during the process facilitates the increase in the presence of phenols in the final product.

We verified that biodynamically produced oils are the ones that reach a higher level of polyphenols. We propose to continue studying this phenomenon to confirm if it is a tendency that is repeated in successive campaigns. On the other hand, harvesting too early does not guarantee a high polyphenol content. Apart from this, it was shown that paste mixing times generate a loss of phenols, which was more marked in olives with a lower ripeness index. In this study, a greater concentration of polyphenols was achieved at intermediate ripeness stages.

It is considered advisable to have a screening variable and use the variable of stability to oxidation, which allows selecting oils that can be packaged with mention of the benefits of polyphenols. An arbequina oil from Terres de Lleida that fulfils the claim must have a stability of at least 15 hours at 120°C. Once this requirement is verified, a more complex analysis can be done based on the determination of secoiridoids, hydroxytyrosol and tyrosol, preferably via a hydrolysis process.

The study recommends not storing unfiltered oils. The analysis of oil conservation made it possible to verify that highly filtered oils, despite their natural evolution, continue to have more favourable attributes and more polyphenol content after a few months than oils with delayed filtration. There were also significant results for the effect of nitrogen. Despite the limitation of having been developed on a pilot scale, we have been able to validate the importance of conserving oils in an inert atmosphere or by always keeping the tanks full.

The initiative allowed all participating companies to know in more detail the composition of the phenolic fraction of their oils and the related sensory attributes. After adapting their production according to the results of the study, it could be verified that oils produced with a degree of ripeness that was not too low and which were filtered immediately after centrifugation and preserved in an inert atmosphere present higher phenol concentrations in all cases.

24

EMBOCHEESE: development of a new concept of sausage cheese and optimisation of the curing process

Leader:
FORMATGERIES MONTBRÚ, SA

Other recipient members:
EDIBLE CASINGS, SL, FIBRAN, SA

Coordinator:
IRTA

The dairy sector is a strategic sector in the Catalan agri-food sector, due to both its economic importance and to its contribution to the development and settlement of rural communities. It is currently in crisis due to the end of the milk quota system, which is leading to the closure, transformation and diversification of several companies in the sector.

The increase in demand for local, quality and innovative products means that companies, in this case cheesemakers, are thinking of developing new products to add value to milk and open up new sales markets, both nationally and internationally.

Today, cheeses can have different shapes depending on the mould in which the curd is placed for ripening. Usually, they tend to be round, cylindrical or square, but there are also other shapes such as that of hung cheese. In Italy, cheeses are produced where the moulding, airing and ripening are done by hanging the cheese.

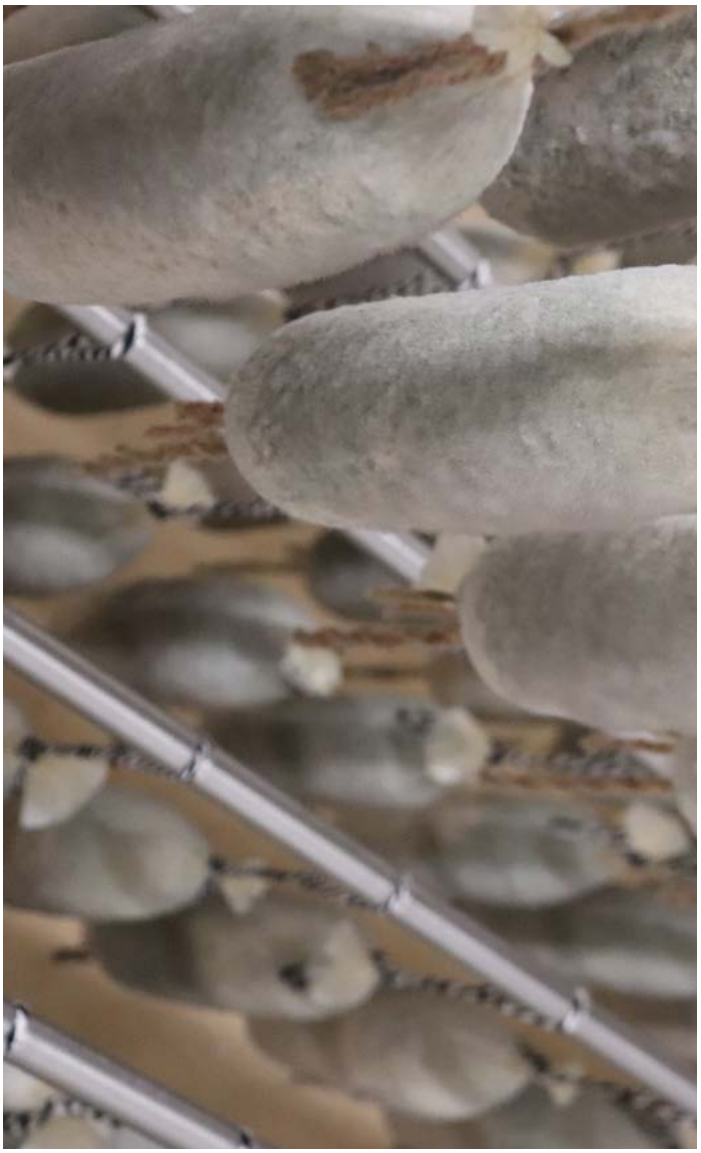
Montbrú, a livestock company and producer of goat's milk and dairy products from Moianès, wanted to take the development of innovative products one step further. Taking the idea of processing a cured meat sausage, Montbrú wants to innovate in the cheese curing system. By using the sausage technique to make the cheese, which is equivalent to the shaping and drying system of a cured sausage, retaining or improving the sensory and nutritional characteristics of the cheese produced can be ensured, with respect to a cheese matured according to the current production system.

In order to place this product on the market, different activities have been carried out to develop and improve the manufacturing technology and the maturation system of a stuffed product. At the same time, different casings and alginates adapted to these types of products have been used to stuff cheese curds.

We have also worked with non-invasive techniques to control the curing of the cheeses. This type of techniques is increasingly used by agri-food companies to characterise the products without having to destroy them. The most well-known technique is NIR, which requires a specific standard curve for the product to be analysed. This technique has been used to determine the moisture and water activity of the product during its curing process, and has allowed this process to be controlled and the technological conditions to be varied depending on the evolution of the product.

Results and conclusions

The tests carried out with the alginate casing process have identified the need to continue working on the mechanisation of the process to obtain more homogeneous stuffed cheeses.



The casings must allow a certain permeability to moisture in order to achieve a proper curing of the product. A high permeability will lead to drier cheeses, while if the casings are very thick, they will not allow a suitable exchange of moisture from the inside of the cheese with the outside.

It has been observed that automatic piston stuffing machinery produces cheeses with a more homogeneous and less grainy texture. On the other hand, cheeses made with worm screw machinery have slightly higher moisture losses.

The stuffed cheese manufacturing process maintains proper hygiene practices in the finished product, with appropriate microbiological results also during its useful life. The packaging of the final product, made in modified atmosphere packaging (MAP) or vacuum sealed, maintains acceptable sensory characteristics until the third week after packaging. Further testing with different types of materials and gases to increase the useful life of the products is recommended.

The project has made it possible to confirm that NIR technology is a resource for future implementation in the field of curing control in these new cheeses, but also in other cheese types and formats. It is a field with many opportunities for the future.

Regarding the consumer study, it was concluded that more than 50% of consumers consider that the cheeses already have proper smell, taste and creaminess. Regarding the assessment of products with packaging, the small cheesefuet has had the best uptake for being more innovative and more hygienic, while the traditional round cheese has been the most well received among products without packaging.

In relation to the outreach activities carried out, there has been a high level of interest both from the media and in the sector and in education. It can therefore be said that innovation in the dairy sector is a highly accepted way to continue working.

25

Automated cutting of meat or meat derivatives to avoid accidents in the workplace and improve productivity and hygiene

Leader:
FRIGORÍFICS COSTA BRAVA, SA

Other recipient members:
ESTEBAN ESPUÑA, SA

Non-recipients:
IRTA

Coordinator:
INNOVACC

The project was based on the development and validation of two prototypes to automate the process of cutting meat and derivatives.

On the one hand, the cutting of meat with saws in existing production lines, focused especially on slaughterhouses and cutting plants. Our intention was to optimise the cutting process for semi-frozen and frozen meat by designing an automatic band saw with a hygienic design to make the process safer and more efficient, from the point of view of both the operator and the product.

On the other hand, work has been done to automate the cutting of cured meat products, mainly for the ham processing industry. The aim was to optimise the cutting process in half of the cured ham by implementing a micro-cutting disc on a conveyor belt leading directly to the slicer in order to optimise the processing from both a productive and operator safety point of view, which at the same time must have an impact on product quality.

Results and conclusions

The project achieved the validation of these two innovative automated cutting systems, which should allow meat companies, both those involved in this project and all those who may be interested, higher precision in cutting fresh and frozen meat and processed meat products.

Automation of the band saw for cutting fresh meat increases the number of pieces of meat processed in the same time as compared to the manual saw. This leads to an increase in both the production and the safety of the operator, due to the equipment protections.

However, the accumulation of product leads to the transfer of the microorganism counts, made in the food safety automatic control , from the surface of the lamb pieces to the surface of the automatic saw in less time. This also happens on the suction table, so the initial surface counts on the cut piece increase and could affect the microbiological quality of the product, shortening its shelf life.

In terms of safety, no food-borne pathogens were detected. The blowing and aspiration system, as conceived in the prototype to be applied after the cut and requiring manual handling, does not improve product quality. Although the prototypes allow for a higher production yield and increased product safety, in terms of microbiological quality they do not improve initial counts.

Finally, it has been concluded that it would be important to complement the equipment design with improvements in terms of facilitating hygiene and disinfection protocols, as well as allowing intermediate cleaning. While the micro-cutting disc system for cured ham does have a design that appears to allow for proper cleaning and disinfection and does not accumulate excessive microbial contamination on its surface, we observed that it could transfer some of the surface contamination of the cut ham, which could affect its microbiological quality.

9

Control of *Monilinia* spp. and *Rhizopus* spp. in stone fruit using new strategies that do not leave residues at the time of harvest

Leader:
FRUITS DE PONENT, SCCL

Other recipient members:
AGROPECUÀRIA I SECCIÓ DE CRÈDIT DE SOSES SCCL, SAT FRUITA D'ALCARRÀS

Coordinator:
IRTA

Brown rot caused by *Monilinia* spp. is one of the main diseases affecting stone fruit in our country. Currently, fruit production is facing a scenario in which it must comply with current legislation and meet consumer requirements and demands, and this makes it necessary to innovate and redesign the fungicide strategies applied so that there is no presence of residues in the final product.

The disease caused by *Rhizopus* spp., which causes soft rot, is another of the main pathogens that affect stone fruit and whose presence has increased in recent years. Unlike with *Monilinia*spp., there is no reliable information available on the effectiveness of registered fungicides to control it. In addition, effective products for controlling this disease are not included in the design of pest and disease control strategies in the field.

This operational group was created with the main objective of controlling post-harvest diseases of peaches and nectarines caused by *Monilinia* spp. and *Rhizopus* spp. through strategies that leave no residue on the fruit at harvest. This would enable a more sustainable production process and access to the most demanding markets.

The initiative has sought to determine the most effective products for controlling *Monilinia* spp. and *Rhizopus* spp., as well as finding out the best time for application and observing the effect of applying them as preventive or curative treatments. It was also necessary to take in to account which field and post-harvest conditions favour their development. The volatile compounds emitted by the fungi that cause these moulds were analysed to see if they can be used as biomarkers to predict their occurrence.

Results and conclusions

Zero-waste strategies were designed and evaluated in the field based on the results obtained from laboratory studies carried out in the first year. It must be said that authorised chemical products in stone fruit for controlling *Monilinia* spp. or *Rhizopus* spp. are detected in multi-residue harvest analyses when applied in the field about one month before har-

vest. Therefore, strategies designed by calendar have mainly incorporated zero-residue products, such as Amylo-X, Serenade Max, Curatio and Julietta.

Early varieties showed low levels of disease in the field and post-harvest, and the effectiveness of the zero-residue strategy was the same as that of the conventional strategy.

For mid-season varieties, the level of disease recorded in the zero-residue strategy was higher in general than in the conventional one. In these cases, we have seen that results do not improve when a zero-residue product is applied after the harvest to the fruit that had zero residue in the field. It should be noted that the effectiveness of the zero-residue strategy in the field is comparable to the conventional one when a chemical product (fludioxonil) is applied after the harvest.

Cultural practices for controlling *Monilinia* spp. are widely studied and it is known that green pruning and the removal of inoculum a few days before harvest favour control of the disease.

By executing this project, we have established that the inoculum of *Rhizopus* spp. is located mainly in the soil of the farms. This fact has led to the incorporation of a third cultural practice based on maintaining plant cover on the farms to act as a physical barrier to dispersion of the inoculum from the soil towards the fruit on the trees.

In the third year of the project, all this information was used to design and validate zero-residue strategies to be applied in the field and supplemented with post-harvest treatments. These strategies were found to show the same level of effectiveness as the conventional strategy for low incidence of the disease. However, for late varieties where inoculum pressure increased, disease levels were higher than those determined for the conventional strategy. In these cases, applying a post-harvest chemical treatment with the Scholar product allow controlling the disease to levels similar to those recorded with the conventional strategy.

It should be noted that, for varieties harvested after late August, the risk of applying a zero-residue strategy is high and, in these cases, other production strategies should be designed that are ¡ sustainable but contain chemical products when the prediction model indicates risk of disease.

In carrying out this project, we have established the importance of studying the epidemiology of diseases in order to be able to better deal with their control. It has been proven that cold storage of stone fruit before marketing could help control the development of *Rhizopus* spp. and avoid the losses caused by this fungus. However, we should recall that other fungi that also affect stone fruit such as *Monilinia* spp. or *Geotrichum* spp. are able to continue growing in the cold, albeit more slowly.

10

POM-ZERO: apple production minimising the use of chemical plant protection agents

Leader:
GIROPOMA COSTA BRAVA, SL

Other recipient members:
SERRATER, SL, CAN RESTA, SCP, PARETA RUBAU, SL

Non-recipients:
MAS BADIA FOUNDATION (IRTA)

Coordinator:
GIROPOMA COSTA BRAVA, SL

One of the current problems in apple production is the presence of plant protection product residues, such as pesticides and fungicides on fruit. This makes them difficult to sell in certain markets and also generates a certain amount of mistrust in consumers and ultimately affects sales. In this context, plant protection products are one of the main avenues for achieving quality production and maximum commercial value, but also cause the presence of residues on apples. Most commercial apple farms primarily use alternatives to conventional chemical treatments, but their dependence on plant protection applications is still very important.

This project has promoted the application of a global strategy for defence against diseases and pests in order to obtain quality production with a minimum of plant protection product residues. This global strategy was based on biological control and alternative methods to conventional chemical treatments in commercial apple plantations completely enclosed by nets. This approach integrates the latest developments in the use of cultural measures and more sustainable biological products.

The project also aims to restore, preserve and improve biodiversity, as well as foster cooperation for innovation between the production sector and research. All these factors should help to improve the competitiveness of apple producers in Girona by allowing them to produce fruit without residues and with high added value.

Results and conclusions

The total closure of farms, in addition to a careful monitoring of pests and diseases and the application of more sustainable strategies, has made it possible to significantly reduce the number of plant protection treatments and achieve a good general control of all pests and diseases and reach undetectable residue levels in the fruit.

It has been possible to significantly reduce the number of insecticide treatments compared to the integrated production farms in the area, which were limited to use of a preventive aphid treatment in some of the farms.

A reduction in the number of fungicidal treatments was obtained, changing the mottling treatment strategy to a strict preventive strategy, thus reducing the number of fungicidal treatments by almost 20%. It was possible to produce fruit without residues by replacing all fungicide treatments for controlling Alternaria leaf blotch and for preservation with potassium bicarbonate.

However, there is a need to strengthen the defence strategy, especially from aphids, by incorporating complementary methods that are compatible with the use of auxiliary fauna to increase the chances of success in controlling these pests. This could be carried out by releasing some specimens of auxiliary fauna and also through improving winter disinfection treatments.

Finally, we observed that total closure appears to have a negative effect on fruit production and quality, which may be associated with changes in environmental conditions.

30

Study of the water cycle in pig farms and development of new methods for reusing water resources

Leader:
GRANGES TERRAGRISA, SL

Non-recipients:
BALMES UNIVERSITY FOUNDATION

The region of Osona is one of the areas most affected by the problem of livestock manure. In this region, the most widely used management option has been by direct application of slurry to the soil as fertiliser. Unfortunately, the transport and application of this manure in other nearby areas with soils of low nutrient content is not a viable option, especially due to the high degree of moisture in the product.

This situation has encouraged the development and implementation of new livestock waste treatment technologies for stabilising organic matter, concentrating and removing nutrients and producing energy. However, none of these technologies have focused on water reuse or have considered comprehensive systems that take advantage of all the effluents obtained through the concept of zero waste.

In order to find a solution to this problem, this operational group has coupled nitrification-denitrification (NDN) systems with electrodialysis and ozonation technologies to treat liquid effluents. This has made it possible to obtain good-quality water that can be reused in the same industrial and agricultural process or for environmental purposes. On the other hand, a composting process was carried out with the solid fractions from the NDN treatment units, such as dehydrated sludge and those obtained from the separator, with the aim of repurposing all the effluents generated in the process.

Results and conclusions

The electrodialysis process for treatment of NDN effluent showed high efficiency in reducing conductivity and potassium content, with a reduction under optimal operational conditions of between 60% and 70%, respectively. The recovery percentages of treated water reached up to 85%.

The two technologies, electrodialysis and ozonisation, when applied in sequence make it possible to reduce the load of emerging organic compounds by around 99%, while the use of electrodialysis alone would achieve reduction percentages of only 50%. The large residual organic load present in the output of the electrodialysis process makes it difficult for microorganisms to be completely eliminated, which prevents the water from having the necessary quality to be repurposed for animal use.

Under the conditions studied, ozonation would make it possible to achieve a final product with sufficient quality to be reused as cleaning water in the facilities according to current regulations.

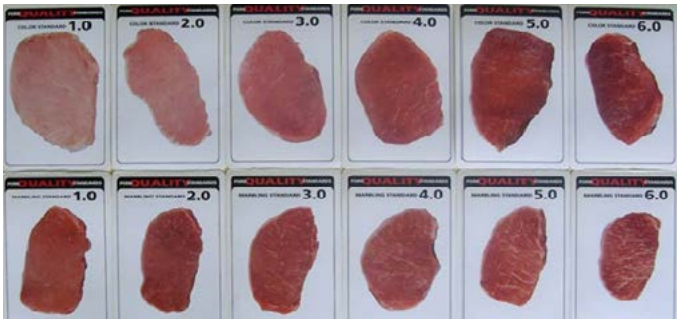
The co-composting process of the solid fraction generates a biostabilised compost that is suitable for agriculture and avoids transport of the concentrated fraction from the electrodialysis process, thereby reducing some of the management costs. Financial savings, when taking into account the initial investment, would only be obtained if the current NDN effluent were to be transported more than 75 km away from the point of origin.

The life cycle analysis shows that the carbon footprint of the current treatment is lower than when implementing the recommended technologies, which would have the same impact as the current situation only if transported more than 18 km away. This carbon footprint is significantly reduced when using renewable energies as an energy source, and the scenarios would be comparable to the case of having to transport the effluents 9.3 km away.

The suggested technologies where the water is returned to the riverbed or reused for cleaning purposes would have a much lower impact on the depletion of water resources, with a reduction in impact of almost 75%.

31

RODAPORK: Duroc selection for a traditional and differentiated pork production model



Leader:
GRUP GEPORK, SA

Other recipient members:
SERVEIS TURÍSTICS LES CABANYES, SLU, INDUSTRIAS CÁRNICAS MONTRONILL, SAU

Non-recipients:
UNIVERSITAT DE MÚRCIA

Coordinator:
INNOVACC

Most pork production with white-coated genotypes is currently based on optimising the ratio between costs and profit, where market prices lead to this production being managed as a commodity. However, every day there are market segments that demand a differentiated product and that value aspects directly related to product quality.

The gastronomic quality criteria is one of those with the most value, and allows the product to be used as an ingredient in an exceptional cuisine with high added value. But ethics should also be mentioned, and these include environmental, economic and social sustainability criteria.

This operational group designed, developed and validated a production model that allows obtaining a specimen capable of providing differentiated meat with a series of specific attributes that meets current market demands. The objective is to achieve a homogeneous product resulting from a genetic program that incorporates different combinations between genetic lines and a deep study of the outbreeding enhancement achieved and complementarity between the lines combined with the Duroc base.

The project took into account all the ethical considerations relating to the production process, without ignoring the imperative need to optimise zootechnical parameters that lead to a more efficient and competitive production in terms of production costs. The final result is that of a raw material that satisfies the requirements of traditional charcuterie and adds the possibility of providing new cuts of meat for restaurants and the gourmet sector.

Results and conclusions

Genetic selection was carried out among specimens of various varieties to achieve the desired product. Each genetic cross expressed a growth curve with specific parameters, which made it possible to create growth models for each genotype and at the same time design bespoke precision feeding programs.

We described the cutting of pieces of gourmet interest from each cross. This information will be necessary in the future to develop marketing strategies for various market segments.

It was observed that the higher the fat content of the Duroc boar used, the higher the intramuscular infiltrated fat content of the final product in any of the crosses studied. It was also observed that there are maternal lines with a greater genetic predisposition to fat content, as is the case of the Landrace line. Regarding lipid deterioration of fat content, the F1 variety is the most sensitive.

The crosses with the best parameters of sensory acceptability by consumers were those that had used the Duroc boar with the most fat infiltration crossed with the F1 maternal line, since they better preserved their organoleptic characteristics when fresh, such as colour, smell and colour intensity over time. They also had better colour intensity and texture when the meat was cooked. The results have guaranteed that this product can enter the gourmet selection.

26

MADURACIÓ: optimization of the maturation system for beef meat based on the selection of the most suitable raw material and the real-time monitoring of chamber conditions

Leader:
MATADERO FRIGORÍFICO DEL CARDONER, SA

Other recipient members:
JANÉ BERTRAN, SL

Coordinator:
IRTA

The production of aged meat consists of taking advantage of the natural ageing process to obtain meat with high added value. The project's main objective was to obtain meat of high sensory quality through an innovative system for the production of aged meat that allows real-time control of technical environmental parameters.

Work was done on improving the body condition of old cows to obtain optimal raw material for ageing and the best time, temperature and humidity conditions were sought in order to obtain a dry-aged beef with excellent sensory qualities.

The initiative also focused on developing new tools such as low cost NIR (near infrared spectroscopy), which allows the ageing process to be controlled quickly and effectively to acquire information that facilitates decision-making, as well as the application of predictive microbiology to minimise the risk of pathogenic microorganism growth.

Results and conclusions

All the tasks carried out by this operational group made it possible to define the most appropriate strategy to produce aged meat from cows that have finished their productive or reproductive cycle.

We first established the importance of obtaining an adequate raw material. Preliminary research was carried out to learn about other experiences in the production of aged meat based on the type of animals that Jané Bertran had available. To finish refining with the resulting theoretical information, the animals and the meat that the company could provide where described, and a fattening strategy was defined for the cows to achieve the characteristics necessary to produce aged meat. The fattening stage made it possible to obtain animals with a body condition higher than 3, and carcasses with a fattening status higher than 3+. The values of these two parameters are considered essential minimum traits to decide how to age a piece of meat.

Regarding the facilities, a combination was chosen of a period of ageing on the carcass followed by the dry-ageing of cuts in specially designed ageing chambers. The evolution of the meat pieces was studied over almost 60 days in different environmental conditions ascertain the changes in important parameters such as weight loss, water activity, water content of the meat cuts, pH, surface colour, the surface colour of fat, the internal colour of the lean meat and the instrumental texture. The spectra obtained with the emerging technology of pocket-sized NIR made it possible to study the evolution of these parameters and work on possible prediction equations. The pocket-sized NIR could thus predict said parameters non-invasively.

The monitoring of the aged cuts for almost 60 days of ageing and the study of predictive models of microbial growth made it possible to identify scenarios where there is a greater risk of pathogen proliferation if initially present in non-aged fresh meat. As a result of this activity, it was decided to discard those carcasses with pH > 5.6 to produce aged meat, and the need was seen to adequately control the temperature of the ageing chamber, at least until the surface water activity of the cuts obtained values of less than 0.95.

Finally, the project has made it possible to build a decision tree to identify the most suitable cuts to produce aged meat, and monitoring criteria for these cuts. The use of emerging methodologies such as pocket-sized NIR and the application of predictive models of microbial growth have made it possible to work with non-invasive strategies to track meat cuts during the ageing process. All in all, it was possible to produce high-quality aged meat that is safe for the consumer.

11

Promotion of the production of barley, corn, alfalfa and oilseeds in organic production for animal feed

Leader:
NUTREX PINSOS, SL

Other recipient members:
CARNS DE CONFIANÇA, SL, AGRO ASSA FOODS, SA

Non-recipients:
MAS BADIA FOUNDATION (IRTA)

Coordinator:
NUTREX PINSOS, SL

There has recently been a strong increase in the demand for animal feed made from raw materials certified as organic. This fact has led to local production of said raw materials to be insufficient and the processing industry having to be supplied from outside Catalonia, which has given rise to a problem of uncertainty in a production system where proximity can be a requirement.

For this reason, most feed companies consider that encouraging the production of organic crops such as cereals (barley, wheat, etc.), legumes (alfalfa, etc.) or oilseeds (rapeseed, soy, etc.) in their immediate environment is a strategic factor. Organic producers need to improve their production processes and introduce new technologies and innovations to be competitive.

The aim of this project led by Nutrex was therefore to promote the production of raw materials such as barley, corn, alfalfa, rapeseed and soybeans to produce local ecological feed by determining the agronomic practices, the costs and the quality of the organic production of these foods.

Results and conclusions

During the monitoring of plots, it was concluded that for the cultivation of organic barley (*Hordeum vulgare*), late sowing during the months of December and January is recommended to avoid excessive infestations by weeds. A higher seeding density than in conventional production is also advisable. Precision hoes show greater efficiency in mechanical weeding, therefore a separation between lines that allows the use of this machinery is recommended.

In the cultivation of organic corn (*Zea mays*), sowing should be delayed so that flowering does not coincide with that of possi-

ble transgenic corn fields nearby, thus avoiding cross-pollination. This makes it appropriate to sow varieties with short cycles that allow harvesting during the months of October and November.

Regarding the organic cultivation of rapeseed (*Brassica napus*), it was concluded that to obtain a good harvest performance it is important to reach the end of winter with a biomass of more than 1.5 kg of rapeseed/m^2. This implies sowing not too late, while also avoiding sowing too early so as not to have excessive weed infestations. Strategies should also be implemented that allow reducing the damage caused by cabbage-stem flea beetles (*Psylliodes chrysocephala*) in the first stages of crop development and by pollen beetles (*Meligethes aeneus*) at the time of flowering.

In general, alfalfa (*Medicago sativa*) has shown good adaptation to organic farming. One of the most important problems can be found in the quality of some of the harvests due to the significant presence of weeds.

Regarding the evaluation of new varieties of barley (*Hordeum vulgare*) and corn (*Zea mays*) in the organic production system, it was observed that it is important to select varieties of barley with characteristics that allow them to compete better with weeds, such as plant cover during the early stages of development and plant height. The fact of not being able to apply fungicides means having to plant varieties that are resistant to the main foliar diseases, especially brown spot complex, which affects crops the most, and, to a lesser degree, brown rust. In corn, it is preferable to have plants with more vigour in the early stages of cultivation, to reduce pest damage and, in a certain way, to better compete with weeds; this is easier to achieve with varieties with shorter cycles, since their vegetative development is faster. Factors such as the resistance to insect damage of different varieties must be taken into account in an attempt to reduce the risk of infection by mycotoxin-producing fungi. In situations of very strong pressure from corn borers, the height of the varieties is important, mainly in areas with strong winds. Above all, it is advised not to delay the harvest too much.

The impact of nitrogen fertilisation on the production, quality and health of barley and corn in organic production was found to be that nitrogen contributions are very limited to bottom fertilisation, which is why it is necessary to look for a fertilisation strategy that guarantees the availability of nitrogen necessary for the proper development of the crop. In general, higher, but moderate, contributions of nitrogenous fertiliser make it possible to achieve acceptable protein contents within the parameters demanded by the industry.

Finally, we determined that it is important to sow soybeans (*Glycine max*) in the right conditions, which lead to proper establishment of the crop. It is necessary to find a weeding strategy that is efficient so as not to compromise the crops.

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Additive-free ham

Leader:
PERNILS LLÉMENA, SA

Other recipient members:
PRODUCTES VALENT, SA

Non-recipients:
FREDOLOT, SL, CIRTTA-UAB

Coordinator:
PERNILS LLÉMENA, SA

The microbiological safety of cured ham has historically been based on the combination of a slightly acidic pH of the meat combined with the use of sodium chloride and nitrifiers. This combination prevents the development of bacterial flora, more specifically *Clostridium botulinum*. This bacterium generates a toxin that is responsible for generating botulism, a serious disease that can even cause death.

The project carried out by Pernils Llémena consisted of obtaining an additive-free cured ham that maintains the same level of food safety as conventional hams.

In this sense, to eliminate the use of nitrifiers and ensure the safety of the product, the company studied the evolution of the bacterium *Clostridium botulinum* during ham processing under different conditions in order to find a workable processing methodology.

This project should help to improve the competitiveness of the company with the creation of a new line of products that will make it possible to respond to a market that is demanding more and more natural products. This will enable expanding the range of customers and support entering new national and international markets.

Results and conclusions

The main results achieved have been to identify the non-growth of *C. botulinum* in the different stages of the ham curing process. The study in question was performed on the first six stages of the process. It was considered irrelevant to carry it out during the storage stage, given that the optimal conditions for growth of the bacterium under study had already been exceeded.

Parameters such as the level of initial contamination, temperature, water activity and pH of the meat were monitored in each of the stages studied. On the other hand, the process was also simulated in predictive microbiology, and the challenge test was carried out in four stages, counting *C. botulinum* in each one. The results of this test show that the current production process, complying with the PC, ensures non-development of the microorganism in the product.

Checks carried out for more than a year show that the presence of *Clostridium botulinum* in fresh hams is very unlikely. In addition, the toxin is produced in the development stage of the microorganism; therefore, by preventing the microorganism's development we can also prevent creation of the toxin.

The study, which was carried out throughout the useful life of the final product, itself packaged in a protective atmosphere, demonstrates the absence of incidences of *Clostridia*. Tests carried out on hams with the same characteristics, but with different salting methods, show that there are hardly any differences in the final product. All microbiological controls demonstrated complete safety, and the physical and chemical parameters were as expected.

Ham without additives has been produced for decades in parts of Europe, such as Italy and southern Spain, and no documented cases of infection or food poisoning have been detected in products produced by the industry in all those years. The production process of the operational group participants maintains conditions very similar to those used in these industries, but taking advantage of the latest technological advances.

The final result of the project concludes that, as long as the current production process is maintained, there is no microbiological risk in the production of additive-free cured ham.

12

Improvement of the process of propagation of certified fruit trees through the in vitro production of mother plants and the rooting of herbaceous cuttings

Leader:
PLAVISE SAT 4920

Other recipient members:
ANTONIO MOLES, VIVERS CAL CORONA DE BARBENS, SL

Non-recipients:
IRTA

Coordinator:
PLAVISE SAT 4920

This operational group was created with the desire to produce rootstocks for fruit trees with a total health guarantee, lower costs than those currently available and a shorter production time, and, at the same time, to produce plants at times when they cannot be produced outdoors.

The project was centred around production in bioreactors, which allow the mother plant to be preserved in the laboratory in a completely healthy state and to produce large quantities of herbaceous cuttings. These are then rooted in rooting tunnels specifically designed so that they are efficient and prepared for different weather conditions.

Results and conclusions

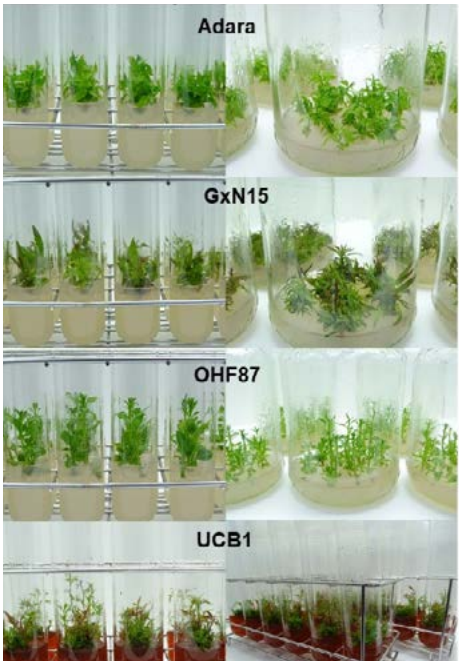
The bioreactor models used to produce the plant material were designed by the *in vitro* plant cultivation laboratory of the Fruit Growing Programme of the IRTA-Fruitcentre in Lleida and are patented by IRTA.

The construction of 24 bioreactors with the species under study was completed, which allowed producing plant material from Adara, Garnem, UCB 1 and OHF 87 in optimal quantities. The species under study were thus shown to be very well adapted to growth in bioreactors.

This plant material was tested in PLAVISE rooting beds with satisfactory results. Problems with endophytes arose in the bioreactor environment during the project, but they could be resolved without major complications.

Rooting took place in 20–30 days depending on the species and, due to the high quality of the plant material provided by the bioreactor, there were very few losses in rooting. It was possible to adapt the rooting area to different climatic conditions. There were considerable variations in the weather variables during the year that were adequately corrected for.

Finished plants were produced in a competitive and very healthy format, in formats of 30–40 cm in alveolus and 40–60 cm in 350 cc containers. The production time varied between four to six months from when the rooting process began until the finished plant. The short duration of this process and its low cost make the technique very attractive with a view to the future.



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Sectoral strategies to prevent caudophagia and to avoid routine tail docking in pigs

Leader:
CATALAN ASSOCIATION OF PORK PRODUCERS

Other recipient members:
SELECCIÓN BATALLÉ, SA, GRANGES TERRAGRISA, SL, CORPORACIÓ ALIMENTÀRIA GUISSONA, SA

Non-recipients:
IRTA

Coordinator:
INNOVACC

The implementation of the particular requirements of Directive 2008/120/EC on the protection of pigs has been the subject of different meetings organised by the EU since 2013 with member states, organisations involved in pig production, scientists and experts of the sector. Based on these meetings, the European Commission has adopted a Recommendation for the application of this directive, establishing minimum standards for the protection of pigs in relation to measures to reduce the need for tail docking. Since the publication of the 2016 Recommendation, the EU's interest in enforcing the regulations has been growing, and audits have been carried out in several EU countries, including Spain.

Therefore, finding strategies to avoid tail biting that work in the productive and climatic conditions of Catalonia is essential for the sector to be able to provide an answer to the EU on whether it is possible to avoid routine tail docking in pigs.

The main objective of this project was to study the effectiveness of different strategies to prevent tail biting in Catalonia, as well as to evaluate different risk factors for the triggering of possible outbreaks. To achieve this, the project provided tools to pig farmers in Catalonia to respond to a legal requirement that represents a sectoral challenge, but it also provided information on whether it is possible to avoid routine tail docking. This would achieve another important long-term strategic objective, which is to increase animal welfare.

Results and conclusions

Several conclusions could be drawn from the tested strategies for preventing taile biting, although the aim of the study was not to compare them with one another due to the number of random factors involved.

First, lowering pig density was observed to have a positive effect in terms of longer tail length both on the farm and in the slaughterhouse, but the severity of injuries in the transition (weaning phase) did not improve.

The improvement of environmental enrichment from "chains" alone to more malleable and fibrous materials indeed showed beneficial effects on injuries to tails. The comparison between "rope" and "straw" hung on a farm in the study showed that the results for the rope were better in terms of length and severity of injuries at the slaughterhouse.

A diet with tranquillisers and pheromones did not show any decisive effects on tail condition.

Broadly speaking, it was found that one of the most critical times in terms of the percentage of animals with wounds, as well as the severity and recency of these wounds, is the end of the transition. Similarly, ear injuries, which may be another point to which exploratory behaviour is redirected, were also observed to worsen at the end of this phase.

The percentage of animals assessed as “no injury” (docked) or with “no severity” (undocked) is lower at the end of the transition compared to the beginning of the transition or during fattening. From here, two conclusions can be drawn, also found in previous studies: (1) more tail biting occurs when tails are not docked; (2) lesions are also observed in docked animals, although not as severe and often not visible to livestock keepers. But it is an aspect that cannot be underestimated, because tail-biting outbreaks that do affect the livestock breeder most likely originate from the fact that there are these initial bites, which indicate a reduction in their capacity to express appropriate exploratory behaviour.

The percentage of ear and body lesions was also significantly higher at the end of the transition and in docked compared to undocked animals. This is an interesting aspect to consider, because although ear injuries are not generally perceived by farmers as an economic or welfare problem, the fact that they occur significantly more in docked pigs could be an indicator that the same lack of a suitable environment for exploratory behaviour suffered by undocked pigs also occurs in docked pigs. The undocked pigs then redirect this need towards the ears, which can be more attractive (especially if the tails are cut to a very short length, as is often the case in Catalonia).

With regard to the data collected at the slaughterhouse, it was noted that there were problems of traceability, which would need to be thoroughly addressed if any system for evaluating tail condition was to be implemented at this level. Despite this, it was possible to obtain interesting data, such as that the average tail length of undocked animals was 20.5 cm (±6.33 cm), which is below the 24–26 cm presented in recent papers from work published with data from pigs in Finland, where docking has been banned for more than 10 years. When length was assessed among those categorised as “tail intact, uninjured”, a length of 25.5 cm (±6.13 cm) was found, also below the 30.6 cm described in this other article with data from 15,000 pigs. One must be very cautious when evaluating these results, firstly because only around 1,000 pigs were evaluated at the slaughterhouse in this study and secondly because of the traceability problems. Despite this, the data indicates that there is still a way to go to achieve optimal results in the prevention of tail biting.

In short, the joint analysis of all the indicators indicated that it is in undocked piglets that the most biting occurs during the transition, which causes them to eventually lose part of their tails. During fattening, the percentage of tails of undocked animals that are assessed as “uninjured” returns to normal levels.However, the length has decreased over time, indicating that the transition injury has healed just as the injury caused by docking has. This result is consistent with the fact that tail inflammation is also assessed as lower during fattening compared to during the transition.

Therefore, further work is needed on improving risk assessment systems to be able to provide adapted data on the interventions that should be implemented on each farm. There are no universal solutions, rather, each farm should be evaluated to identify the risks in that farm and prepare preventive strategies accordingly.

Finally, it was concluded that the slaughterhouse can be a more objective data collection point and easier to evaluate than on farms, but a top-tier traceability system needs to be established and the slaughterhouse data should be used to inform livestock farmers and help them improve their operations.

33

WELBEEF: creation of handling guidelines during the calf pre-slaughter stage to improve welfare and reduce the incidence of DFD and petechia

Leader:
SALA DE DESFER I MAGATZEM FRIGORÍFIC J. VIÑAS, SA

Other recipient members:
COOPERATIVA D'IVARS I SECTOR DE CRÈDIT, SCCL

Non-recipients:
IRTA

Coordinator:
ASSOCIATION OF BEEF BUSINESSMEN OF ALCARRÀS

The pre-slaughter phase, which involves all the changes in conditions and activities before slaughter, such as changes in ambient temperature, loading and unloading of calves at the farm and slaughterhouse, transport, mixing of animals, waiting time in the slaughterhouse or type of slaughter, can negatively affect meat quality. There are many studies that show that the stress experienced by animals during these changes in conditions and activities varies depending on the duration and intensity, thus increasing the proportion of negative effects on the meat. Stress and physical activity generate a depletion of glycogen in the muscle that results in an increase in pH, which causes changes in the physical appearance of the meat, which is then called DFD (dark, firm, dry) meat.

At the sectoral meeting in April 2018, consisting of different representatives of the feeder cattle sector, the project *Factors for pre-slaughter phase and the reduction of meat petechiae and DFD* was chosen as a priority. The WELBEEF project was created as an answer to this need, and aims to improve and evaluate pre-slaughter practices related to animal welfare that have direct consequences on meat and carcass quality.

The ultimate goal of the operational group is to prepare a reference guide to handling during the pre-slaughter of feeder calves. To achieve this, it is necessary to know the effects on meat of practices during the three phases undergone by some of the pre-slaughter animals: to understand the effect of heat stress (climate change) and evaluate on-farm heat reduction strategies prior to slaughter; to evaluate the effect of waiting time before slaughter for short and long transports and the effect of breed; and, finally, to study the human-animal interaction in the handling between the slaughterhouse waiting pens and the time of sacrifice.

Results and conclusions

The results obtained from the evaluation of the different pre-sacrifice phases have helped determine, first of all, that the use of blade fans on the farm installed between two pens led to a lower pH in the carcasses. In addition, it could also serve as a strategy to reduce the use of straw and extend the time between bed cleaning days for farm staff, as this reduces the dirt level of the pens and the moisture of the manure. However, it was observed that it decreased calf growth, increased feed consumption and increased the amount of time the animals spend standing under the fans. Therefore, it is not a good strategy for improving the production, comfort and welfare of calves.

Secondly, taking into account the human-animal interaction prior to slaughter, the initiative managed to implement a protocol for electric stunning, because an amperage of more than 1.5 A and a frequency of 50 Hz applied for 3 seconds achieves a long enough stun to slaughter the animals through a humane killing and they do not reach the start phase of normal rhythmic breathing.

Finally, the waiting time at the slaughterhouse based on transport duration and breed has had a rather small effect on meat quality parameters such as pH, colour, colour stability in MAP (modified-atmosphere packaging) and microbiological contamination, both in short and long transports from the farm to the slaughterhouse.

Animal behaviour during the waiting time varied depending on the transport time from the farm to the slaughterhouse. In short transports, the calves decrease their activity over time, while, in long transports, after three hours of waiting they start to be more active and this may be related to the greater number of hours that the animals are fasting.

The breed of the animals had an impact on meat quality parameters. Cross-bred calves showed more DFD carcasses and their loins show lower brightness and a greater tendency towards red and yellow.

13

Increasing the productive and economic performance of cherry cultivation through new architectural systems

Leader:
SAT BEPA

Non-recipients:
CATALAN INTEGRATED PRODUCTION COUNCIL (CCPI), AFRUCAT, IRTA

One of the main problems currently affecting cherry cultivation is, on the one hand, the high cost of handling, since 80% of the cost associated with this cultivation is due to maintenance tasks such as thinning and harvest, and, on the other hand, the fact that it is a crop that enters full production late -that is to say, after the tree is three years old- which makes it extremely difficult to adapt it to the demanding needs of a constantly changing market.

For this reason, one of the solutions proposed through this project was to act on young trees in their development stages and with a very early entry into production, and by evaluating different tree-training techniques, obtaining trees with earlier productivity. In addition, by the selective modification of their training, it could be possible to generate a cultivar with more uniform characteristics, which would produce more standardised harvests and fruit qualities in terms of calibres and ripeness levels.

The resulting handling system must be simpler, of lower economic and labour costs and at the same time must generate a uniform harvest in terms of quality and quantity. In addition, it must support an early entry into crop production.

Results and conclusions

The project concluded that the new training systems (UFO and KGB) made it possible to increase cherry production per square meter, compared to Got training. The UFO system proved to be very productive, but requires a higher initial investment. This is due to the high density of trees, the structure needed to support them and the requirement of a deeper prior technical knowledge, but once they are formed, it allows mechanising the rinsing of flowers and fruits and facilitates the harvest. In addition, UFO-trained cherry trees entered production earlier than traditional Got-trained cherry trees.

The KGB training system was the most productive system of all, due to the volume the trees reach and the rapid entry into production. It is a system that is easy to handle and does not require a structure, with a smaller initial investment than UFO. On the other hand, tasks are more difficult to mechanise in this system and, if a good rinse is not carried out, this can have a negative impact on the final size of the fruit.

The increase in planting density made it possible to reduce the volume of plant protection agents applied per tonne of fruit produced. The training system influenced fruit size and size distribution, because this variable is closely linked to production. Thus, large sizes could be obtained if the number of cherries was reduced by thinning flowers or fruits. In addition, training system had no effect on other quality parameters.

Finally, it was possible to conclude that the new training systems did not affect other quality parameters (such as degrees Brix, colour, firmness).

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GO COLOR 4.0

Leader:
SAT N197 FRUILAR, SL

Other recipient members:
FOMENT AGRÍCOLA LES PLANES, SCCL, SAT TORNAFRUIT N.19-CAT

Non-recipients:
IRTA

Coordinator:
AFRUCAT

Improving the colouring of bicolour cultivars is key in plantation profitability, since the price received by farmers is defined according to the percentage of colour and the calibre or size of the fruit. In the case of colour, if less than 60% of the surface of the fruit is coloured, it is not considered commercial, regardless of size. This means that even large-calibre fruits are discarded for commercial sale if they do not meet the established colour criteria, which leads to significant losses, both from the economic point of view and as wasted fruit.

Losses associated with lack of colouring in bicolour apples are a recurring problem every year, so there is a significant part of the crop that does not reach the coloured surface threshold for the fruit and is harvested for processing as juice or, in the worst case scenario, stays in the field.
The lack of colouring of bicolour apples is caused by multiple factors, but the main one is meteorological, closely linked to high temperatures in the weeks before harvesting This takes place in most of the production areas in Catalonia. The best way to compensate for this limitation is to use clones with high colouration. But in the case of already established plantations, the best way is to train the trees to improve the entry of light. This option is strongly conditioned by the vigour of the plantation, so fertilisation, irrigation and the use of plant growth regulators to reduce tree vigour are of particular importance. However, there are other options, such as reducing the load or the number of fruits per tree, the use of products that have a certain effectiveness, refractory nets placed on the ground or defoliation of the trees a few weeks before harvest.

The main objective of this project was to categorise plots based on their vigour using satellite images, to then be able to draw up a protocol of measures to improve the colour for each particular situation. Remote sensing could currently be one of the most powerful tools to categorise the vigour of plantations in a fast, robust and economical way, allowing scalability of the system.

Additionally, other options were evaluated to improve the colouring of bicolour apples, some of which are used in other countries, and whose effectiveness in our unfavourable growing conditions is unknown. For example, there are some techniques that have begun to be studied that may be of interest in late bicolour apples such as *Fuji* and *Pink Lady*

varieties, such as tree defoliation. Another possibility would be the use of certain groups of plant growth regulators that produce physiological changes that favour the colouring of the fruits. These products, however, require testing in conditions in Catalonia, as well as studies of their economic profitability.

Results and conclusions

The categorisation of plots based on satellite images was successful, with results that were fully comparable with measurements in the field. It was thus possible to confirm that the plots were correctly categorised using the E-Stratos platform. On the other hand, a strong direct relationship was not found between the vigour category of the plots and fruit colour. In other words, there are plots of high vigour with very good colouration, and others with a lack of colour, and the same goes for other categories of vigour.

Regarding the biostimulation strategies evaluated, the application of the plant growth regulator Ethephon was one of the best performing to increase colouration in general. On the other hand, Stoller's Chromafruit product, with the ability to naturally promote the synthesis of colour pigments (carotenoids and anthocyanins), seems to increase mostly the percentage of fruits above 90% colour. In high vigour plots the Ethephon product worked better. At low vigour, Stoller applied to plots without defoliation provided results comparable to manual defoliation.

It should also be noted that, during the two years these strategies were evaluated (2020–2021), the climatic conditions were highly favourable to fruit colouring, a fact that has led to even the control treatments having excellent colouring. However, this has meant that the possible effects of the treatments could have been obscured.

Regarding the evaluation of the handling of defoliation operations, the vertical position of the Redpulse mechanical defoliator works better than horizontal defoliators, although the training of the trees plays a relevant role. In low vigour and flat systems the differences are smaller. The ideal time for defoliation is between two and three weeks before harvest; four weeks is too soon and one week too late. Doing two passes seems to increase the colouring, but it can be counter-productive if the process is not performed carefully, as more fruit can be knocked off the trees.

In terms of nitrogen fertilisation management, the complexity of the design, plus the application of each treatment and the response time makes it very difficult to have conclusive results in little over two or three years.

Finally, chemical defoliation has remarkably favoured colouration in Gala, but the fact that it causes aesthetic damage in 5%–10% of the pieces rules it out as a recommended strategy.

Therefore, it can be concluded that the Chromafruit treatment is currently one of the best for colour enhancement.

34

Q-OLOR: Strategies for obtaining pork without sexual odour

Leader:
SELECCIÓN BATALLÉ, SA

Other recipient members:
GRUP GEPORK, SA, UPB GENETIC WORLD, SL, FRIGORÍFICOS DEL NORDESTE, SA

Non-recipients:
IRTA

Coordinator:
INNOVACC

Surgical castration in piglets is mainly practised to facilitate handling of the animals, since uncastrated animals are more aggressive and have a more active sexual behaviour. In addition, there is the fact that food consumption and the conversion index are lower for uncastrated males than for surgically castrated ones, which gives different characteristics to carcasses, which are leaner in uncsatrated animals.

On a sensory scale, the production of uncastrated males presents a major problem: the sexual odour known as boar taint, which is an unpleasant smell (and taste), is associated mainly with two compounds, androstenone (5α-androst-16-en-3-one) and skatole (3-methylindole). This smell can produce rejection of the meat by consumers, especially the most sensitive consumers.

However, surgical castration is painful and not good for animal welfare. For this reason, in Europe efforts are being made to abolish the surgical castration of pigs without anaesthesia or analgesia and to replace it with alternatives.

This operational group pursued the objective of achieving alternatives to surgical castration in the production of male pig meat, as well as the evaluation of boar taint in the slaughterhouse, with the aim of meeting the needs of consumers without having negative consequences for the pig sector.

On the one hand, work was done on a farm scale with the application of one of the alternatives to surgical castration and the production of uncastrated males, a process known as immunocastration. Various vaccine application guidelines were studied and their effect on production yields, meat and carcass quality and elimination of the boar taint problem on a sensory scale were evaluated.

Work was also done with the other alternative to surgical castration, which is the production of uncastrated males. The possibility of indirect selection by level of aggression and direct selection for genetic markers of boar taint was evaluated, with the aim of reducing the number of carcasses with a higher probability of incidence of this defect. The relationship between pig aggressiveness and the presence of boar taint in the meat was also determined.

Finally, due to the possibility of having a sexual smell with any of these methods, even though very small, it was ensured that the carcasses presenting the problem were detected in order to separate them. These carcasses could be targeted towards markets where boar taint is not a problem or masking strategies could be applied to reduce it. For this reason, action was taken to determine boar taint with a non-invasive sensor, which is expected to have the potential to be automated and be included on the slaughter line.

Results and conclusions

First of all, work was done on immunocastration guidelines to achieve carcasses of good quality -- that is, maximum infiltration of the meat and meat free of boar taint. The results after application of the guidelines showed that both late and early immunocastration affects the productive parameters, although this effect is not the same over all the batches analysed. In general, intact males showed a lower conversion rate than immunocastrated animals, both early and late.

Regarding carcass quality parameters, the effect of immunocastration led to a greater variability of treated carcasses, which increased with increasing immunocastration time. In general, carcases from early and late immunocastrated animals were fattier and less lean than those from intact animals, although this claim was not made in some batches. Regarding meat quality parameters, they were not affected by the different immunocastration guidelines. Finally, the human nose results show that both late and early immunocastration eliminate boar taint, although in a small number of animals it can be perceived faintly, especially with early immunocastration.

Secondly, work was done on genetic selection. The classification of boar taint with the human nose made it possible to relate the genotypes of the genetic markers studied, either individually or in combination, with the level of boar taint. The results show that, although individually it is difficult to find a marker that allows obtaining a high percentage of animals without boar taint, the combination of markers makes it possible to have between 82% and 95% of pigs negative for boar taint. We studied the effect of carcass characteristics and the genotype of the different markers selected for the animal, its father and its mother, in the presence of boar taint, and observed that the most important factors were the percentage carcass leanness, back fat thickness and carcass skin lesions. The fatter the animals are, the more presence of sexual odor there is, and also the more lesions on the skin of the carcass,the lower percentage of animals with a negative sexual odor or, in other words, the greater the presence of boar taint. It was also observed that some genotype of the genetic markers of boar taint studied is related to pig aggressiveness, which indicates that the genes associated with some of the genetic markers could affect physiological mechanisms common to the manifestation of aggression and the presence of boar taint.

Finally, the functionality of the Raman sensor was studied, which makes it possible to establish a classification model of fat according to the presence or absence of boar taint based on androstenone and skatole levels obtained by chemical analysis, with an error of 25%. In the validation phase, this error was around 28%–40%. It also enables establishing a classification of fat (with smell/without smell), according to the sexual odor values evaluated with the human nose, with a similar error (34%–38%). However, the prediction of androstenone and skatole levels with the Raman sensor is imprecise. Both the human nose and Raman can classify samples as positive or negative for boar taint with similar error. It is concluded that other non-invasive and faster technologies than Raman, such as NIR (near-infrared spectroscopy), can be tried for boar taint classification on the production line.

28

5-PROTEG: Ready-to-eat processed food for the elderly based on meat protein

Leader:
GASTROGUST CUINATS, SL

Other recipient members:
MATADERO FRIGORÍFICO DEL CARDONER, SA

Non-recipients:
EURECAT FOUNDATION

Coordinator:
INNOVACC

The main objective of the project was to develop ready-to-eat dishes that provide the necessary nutritional requirements for the segment of the elderly population in good health. Ready-to-eat processed foods include cooked and packaged dishes ready for human consumption which, in the end, need only a final heating by the end consumer.

The project was requested by Taller de Cuina Bon Gust, a company with experience in the sector of pre-cooked dishes, together with Matadero Frigorífico del Cardoner, a company in the meat sector dedicated to the slaughtering, cutting and processing of meat products, which have been able to count on the collaboration of the Eurecat Foundation technology centre and the coordination of INNOVACC.

At the same time, the possibility of incorporating ingredients that make it possible to apply a health declaration on ready-to-eat dishes was investigated.

The project was based on the identification and selection of local ingredients suitable for the specific requirements of the elderly. Work was also done on optimising the preparation process of ready-to-eat dishes with selected cuts of meat in order to meet the nutritional requirements of this population group.

We thus intended to meet the needs both of people who live alone or as a couple, as well as those of gerontological centres with their own kitchens or that have the ability to include ready-to-eat products in the meals they offer to their users.

Results and conclusions

The project made it possible to develop a battery of prepared dishes (10–12), of which three prototypes were studied on a pilot scale, based on adding value to cuts of meat of low commercial value with other local ingredients and according to nutritional requirements for the elderly, whose nutritional, sensory and food safety properties were evaluated throughout the 90 days of useful life with satisfactory results. The prototypes were: cabbage cannelloni with lamb and pumpkin sauce; meat ball stuffed with Gorgonzola and walnuts with shredded potatoes and smoked bacon, and pork feet stuffed with pepper sauce.

The three ready-to-eat dishes tested allow including the nutritional declaration of high protein content, which is responsive to the main objective of the project. In addition, the dish of cabbage cannelloni stuffed with lamb and pumpkin sauce also allows including a declaration of source of fibre, which provides nutritional value to the dish and complements the contribution to the segment of the population to which it is directed.

Finally, the project enabled identifying the nutritional requirements of the senior population segment, which are covered with the different ingredients of the resulting dishes.

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Diversification of the cultivation of edible mushrooms with new indigenous species

Leader:
TEB VERD, SCCL

Non-recipients:
IRTA, GREMI FUSTA I MOBLE, TRESSERAS MULTIMEDIA, SL, BOLETS DE SOCA, CATALAN MYCOLOGICAL SOCIETY

Catalonia is a country with a strong and broadly practised mycological tradition, but the cultivation of wood mushrooms focuses on a few species, which come mainly from the Asian tradition, which itself is a pioneer in this type of cultivation. Diversification towards other species that are more closely related to local tradition would increase the diversity and current supply of edible mushrooms. These new products would give local producers a competitive advantage and open up new export prospects.

The main objective of this operational group was to incorporate new species of fungi into edible mushroom cultivation, which is mostly lignicolous and indigenous to Catalonia. Mushroom production could be diversified and the commercial offer of local producers improved.

The project was led by Teb Verd and also includes Bolets de Soca, the Catalan Mycological Society, the Gremi Fusta i Moble and IRTA, which has acted as a technological or research centre, whose research team was joined by two professors from the University of Barcelona.

Results and conclusions

From the specimens collected in the field, 120 strains of 14 species of fungi were isolated. A mixture of wheat grain, rye and molasses in equal parts, with a water content adjusted to 50%–60% and sterilised in an autoclave, was designed and successfully tested for the production of inoculum with 87 different strains of 11 fungal species. Small-scale trials were conducted using a hardwood sawdust substrate adjusted to 60%–65% moisture. An incubation temperature of 20–25°C was suitable for all species.

The work performed in the project made it possible to fine tune the methods and protocols for the cultivation of eight edible fungi species from indigenous strains. Cultivation protocols can be considered finalised for *Agrocybe aegerita*, *Fistulina hepatica*, *Lyophyllum decastes*, *Meripilus giganteus*, *Pleurotus eryngii* and *Polyporus squamosus*. It was also possible to carry out the project, with the use of indigenous strains, for more well-known species such as *Ganoderma lucidum* and *Grifola frondosa*. Nutrient and cytotoxicity analyses of all new cultivated species are currently underway.

With *Laetiporus sulphureus,* the complete cultivation cycle has not yet been achieved, so no mushrooms have been obtained. Interest in the species has led to the start of a dissertation at the University of Barcelona to continue the research.

We can conclude that the diversification of the cultivation of edible mushrooms should continue over time, in order to gradually incorporate new products into the market. Cooperation between companies in the sector and research centres, with the support of government institutions, has proven to be a good way to achieve these results. In addition, the collection of pure cultures derived from this project remains available for future research and development work.

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Improvement of the technical and economic management of extensive livestock farms in the Catalan Pyrenees using geolocation and animal monitoring systems

Leader:
FARMERS' UNION OF CATALONIA

Other recipient members:
AGRÀRIA RAMADERA DEL PALLARS DE SORT, SCCL, PIRENAICA, SCCL

Non-recipients:
DIGITANIMAL, SL, IRTA

Coordinator:
FARMERS' UNION OF CATALONIA

The aim of the project was to provide new technological tools for the extensive livestock sector that allow obtaining and managing the maximum possible data from a herd with minimal intervention by the farmer. The geolocation and monitoring of animals makes it possible to analyse, through various algorithms, the information collected to detect possible incidents and improve the management of animals and pastures. This operational group, formed by the Unió de Pagesos de Catalunya (Farmers' Union of Catalonia), the Agrifood Research and Technology Institute, Digitanimal and the cooperatives Pirenaica and Agrària Ramadera del Pallars de Sort, focused on exploring all the potential these technologies can offer to help overcome the main challenges in the sector.

One of the main aspects of the project was to improve the economic viability of the farms, by adjusting the devices to the activity patterns of the herds to improve technical, sanitary and economic management. The actions should make it easier to locate, control the movements and monitor the condition of animals and herds, as well as reduce the hours dedicated to such tasks.

The efficient and sustainable use of natural resources was also tested during the project, as well as the maintenance of biodiversity, and the grouped data relating to the location of the animals was also analysed in order to calculate the grazing pressure, preserving the quality and guaranteeing the sustainability of the silvopastoral system.

Finally, the coexistence of herds with wild fauna was observed. We assessed the effectiveness of this technology to detect wild animal attacks and an attempt was made to establish behavioural patterns in order to be able to detect and document them.

Results and conclusions

The project was divided into five actions in order to respond to the objectives set.

First, the use of a geolocation and animal monitoring system was put into practice to detect deficiencies and any improvements needed to carry out subsequent actions. The result was that, although the Upper Pyrenees area presents significant difficulties to the use of geolocation technologies due to lack of coverage, there are possible solutions that are ready to be implemented. The cheaper solutions, based on mobile network coverage collars or Sigfox, have provided good results, but have limitations. In the case of mobile network coverage, the limitation was in the cost of the antennas, and in the case of Sigfox coverage, the fee that must be paid for the use of the service and the limit on the number of messages that can be sent in a day. Where the two types of systems were compared, there was no clear advantage of one over the other.

Secondly, the behaviour of the herds was studied to determine patterns that can be used to manage pastures sustainably. In this context, it was observed that the data obtained with the collars, even with emissivities below 50% -which is equivalent to an average of one message per hour- were useful to know where the animals graze. By using heat maps or crossing the data with other map layers through geographical information systems (GIS) it was possible to extract useful information in relation to the use of resources, excessive stock density in certain areas or the underutilisation of other areas that may lead to a future loss of grazing areas.

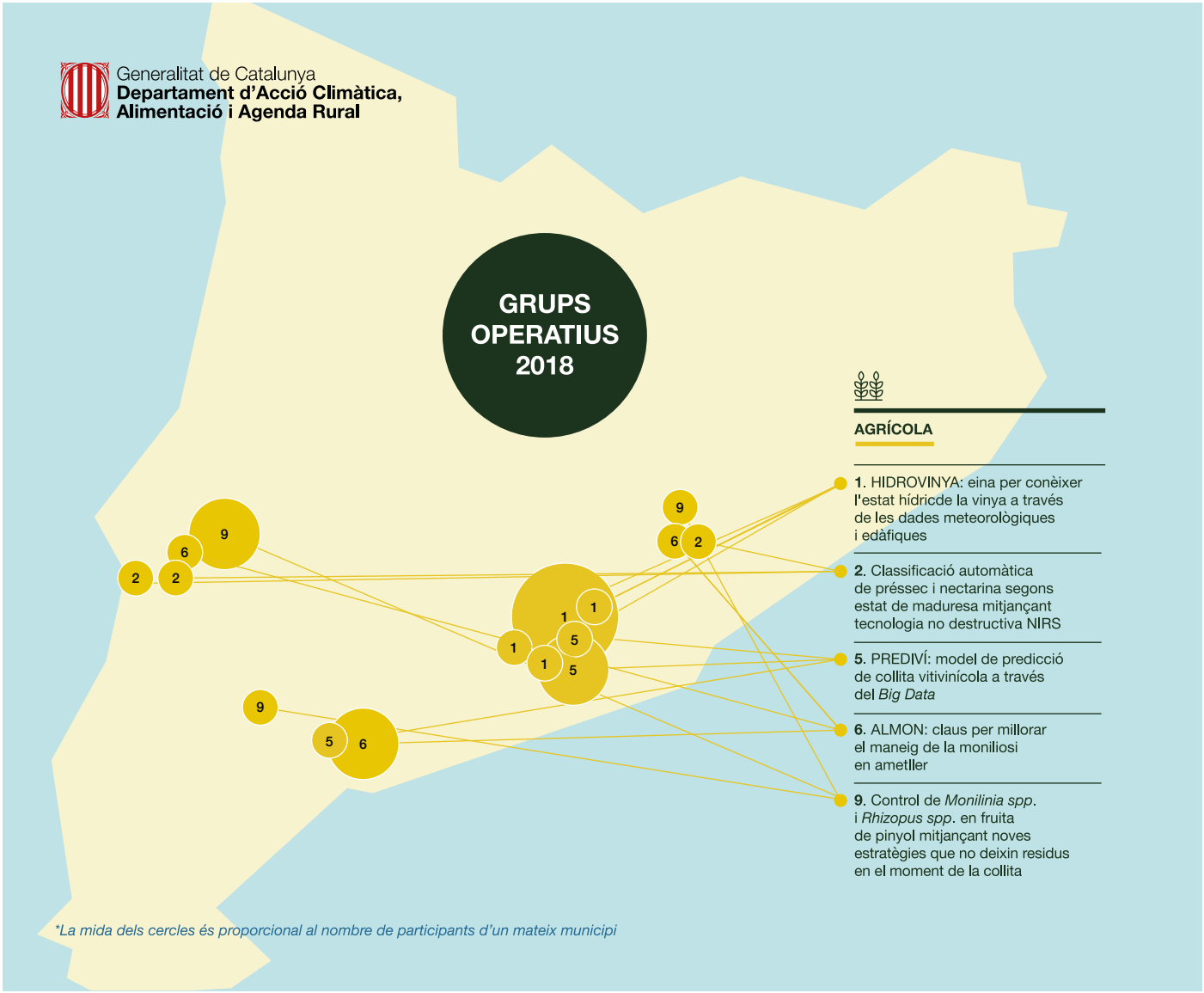
The third aspect studied was the activity and temperature data of the animals The goal was being able to detect their condition

and adjust the activity patterns to the conditions of the study area and, in this way, improve the technical, sanitary and economic management of farms. It was concluded that the temperature sensors of the collars can be useful, more for the variation patterns they register than for the temperature values provided(which can vary between animals depending on how the collar is placed) as these variation patterns can help to indicate changes in animal activity. This is because when the animal moves its head, the sensor moves closer and further away from the neck and therefore the recorded temperature also varies. However, significant changes in the average temperature patterns of an entire herd can indicate important issues that require consideration.

While the alarm system was able to detect an animal with mastitis and the combination of activity and temperature can be useful in identifying a pregnant animal about to give birth, lame animals did not show clear enough patterns to be identified by the system from the data obtained. As such, more detailed information will be necessary to be able to identify this type of animal. In sheep, information from the whole day can be used to learn the movements and flocks' use of space, but to know the state of the animals it is better to focus on the night hours, which are those in which there is no human intervention.

Fourthly, we evaluated the costs and savings involved in the use of the tested technology with respect to current farm management. The results led us to conclude that the use of this tool does not generate significant economic savings within the productive system. Rather, it generates improvements in the management of the animals, pastures and an optimisation of the farmer's or rancher's time. Comparing productive systems that use collars with those that do not, improvements were observed in different aspects. On the one hand, there was a lower number of hours dedicated (hours in the pastures times the frequency with which they visit them) to the herds that used collars. On the other hand, they speed up and improve herd management in the pastures. The time taken to locate animals decreases in grazing areas, a key aspect in high mountain areas where access is difficult. Likewise, it was confirmed that the use of GPS collars also helps to identify if there are any animals with health problems and to detect wildlife attacks, both very important aspects for herds that are in the high mountains.

Finally, this technology was tested in simulated wildlife herd attack situations to record the reaction of the animals or herds and adjust activity patterns in cases of suspected wildlife attacks. The result was that, despite the low incidence of potential bear attacks in the study and the problems of collar coverage in many places of the study area, this technology showed a good potential to be able to warn the farmer of behavioural alterations compatible with the presence of this predator, as changes in animal activity or surface temperature were detected in cases where a bear attack occurred or when a bear was known to be in the area. In the future, with more data available, it should be possible to generate an alarm using information generated by the system and appropriate algorithms.



We talk to:

ROSANA GARCIA

IRTA

Rosana Garcia Fornieles is an agricultural technical engineer from the University of Lleida. Her professional career as IRTA's business developer has focused on the field of innovation. Her career is linked to collecting resources through promoting contracting with companies in the IRTA's plants area, and for many years she has worked with the aim of bringing research closer to producers, technicians and companies in the agri-food sector.

ELOI MONTCADA

INNOVI

Eloi Montcada Elías is an agronomist with a postgraduate degree in Business Environmental Management and European Agriculture and the CAP. He has more than 20 years of experience in the fields of sustainability and innovation, during which he has directed, coordinated and participated in many R+D+I projects. He has collaborated with different organisations such as the European Economic and Social Committee or AENOR, the Spanish Association for Standardisation and Certification, and has taught different master's and postgraduate courses in business management, innovation and sustainability.

He is currently the cluster manager of INNOVI, the Catalan wine business cluster. This association aims to make the wine sector more competitive by promoting innovation along the entire wine value chain: winegrowers, wineries, industry and auxiliary services, technology centres and universities.

ROSANA GARCIA

Are you satisfied with the progress of the project and with the results obtained?

The development of the projects was very satisfactory, the involvement of the entities participating in the different consortiums and their willingness favoured working at a good pace. This commitment made it possible to achieve the specific objectives of the projects to one degree or another, but in any case the information and knowledge generated made it possible to reach sufficient conclusions to determine the next steps to follow and assess the possible path from the results obtained.

As a result of this operational group, have interactions and cooperations emerged that allow you to continue collaborating beyond this project?

Yes, the very interaction between consortium members during project work meetings gave rise to very productive debates and conversations where needs were highlighted, challenges were identified and possible solutions were proposed. This can be the starting point for new projects, where IRTA technicians, producers and researchers intervene to assess the feasibility and technical solutions to the different challenges.

Then, from the IRTA Projects and Contracts Office we propose the most suitable funding to apply for with the best chance of success depending on the type of project. We have several successful cases of "consolidated" consortia that have decided to present new projects this year, the result of the positive balance they gain from the experience.

One of the most important factors of the operational groups are the relationships and links created between the companies and the research centre.

What aspects of this experience do you value most positively?

The call for operational groups is a strategic call for IRTA, as it allows us to connect and communicate with the sector very closely. In the same way, one of the most important factors are the relationships and the links created between the companies and the research centre. These links, which in most cases are maintained beyond the duration of the project, make it easier for us to know first-hand the needs of the sector and at the same time make our lines of research known to the different companies.

These types of projects are a good tool that encourages innovation in companies.

What aspects would you improve?

Perhaps a point that often creates problems for us is the duration of the projects or the fact that requesting extensions for execution of the projects is not simpler. When we talk about agronomic aspects, there are unpredictable external factors such as the climate, among others, that can negatively affect the execution of the project.

Do you think that this type of projects are a good tool to encourage innovation and knowledge transfer in the sector?

Absolutely. Without a doubt, it is a tool that encourages in-

novation by the companies. The call is subsidised at a very attractive percentage and its economic management is simple, which means that companies find the call for proposals interesting.

On the one hand, companies that have integrated innovation programmess in their operations have more resources to make more ambitious project proposals than they might do with their own resources and, on the other hand, companies that are not used to or have few resources available for innovation can be involved in projects and get in contact with research.

I consider that this is a very successful call and that it has a direct impact on the sector, as it provides access to research and improves the competitive positioning of our agrifood companies.

ELOI MONTCADA

Are you satisfied with the development of the project and with its results?

The PREDIVI project, a wine harvest prediction model using big data, is part of a strategy of creating decision support tools (DSS) based on predictions using big data and artificial intelligence. While this project aims to predict the amount and degree of ripeness of the harvest, others focus on quality parameters and yet others go beyond the harvest and analyse geographical location and growing condition variables, as well as phenological variables to predict plant protection applications or irrigation water needs.

The agricultural sector increasingly requires technologies to help make the best decisions in terms of effectiveness and efficiency, from deciding the date of the harvest to applying plant protection products or fertilisers. The project has contributed towards gaining knowledge of the technologies and their limitations. For example, we have found that, with satellite data alone, the approximation is good enough, but the margins of error can be reduced if the images are taken at ground level.

The agricultural sector increasingly requires technologies to help make the best decisions in terms of effectiveness and efficiency, from deciding the date of the harvest to applying plant protection products or fertilisers. The project has contributed to gaining knowledge of the technologies and their limitations.

As a result of this operational group, have relationships and cooperations emerged that allow you to continue collaborating beyond this project?

On the one hand, synergies have emerged between the participants, which often go beyond the strict scope of the project and which put other challenges on the table that need to be answered. During the project, the winegrowers and wineries establish very close relationships with the technology centres and the companies providing innovation, and a climate of trust is created that allows looking for solutions to other issues. Precisely as a result of this project came the need for tools for traceability from the grape to the bottle or from the winegrower to the consumer.

The technical level reached by these projects often allows opening new ideas derived from the original work.

In this specific case, we saw that by using the data used for crop predictions we could establish predictive models for plant protection treatments. We also want to highlight the synergies established not only between the members of the project consortium, but with other projects that we have underway in which weather stations were installed. When we want to give intelligence to the data obtained in the field, it is important to have the highest number of replications possible in order to draw the most accurate conclusions possible. One of the results of this project is the initiative we are currently running, which will create a common and, very importantly, an open data database, and will allow technological centres and companies in the wine sector to innovate and study the effects of climate change.

What aspects of this experience do you value most positively?

Contrary to what you might think, the most interesting aspects of the project arose precisely from the limitations and errors that emerged. In the field of innovation it is very important to be able to detect which parameters, variables or processes need to be improved to obtain better results.

One of the results of this project is the initiative we are currently running, which will create a common and, very importantly, an open database, and will allow technological centres and companies in the wine sector to innovate and study the effects of climate change.

One of the limitations of Zenithal images is the difficulty of seeing the fruit; in our case, grapes. To be able to predict the amount, it would be much prefererable, at some point in the phenological process, to have ground-level images, which could be obtained from the same sector. Analysing this image together with the satellite images would significantly improve the accuracy.

On the other hand, the meteorological data at plot level have been inferred from meteorological models and the few stations available in the territory. Having data from closer to the plots and with other agronomic parameters would help improve the accuracy of the system. During 2022 more than 40 weather stations were installed in the Penedès region, which will help improve predictions in the different areas in which work is done.

What aspects would you improve?

In the technical field, the call is very flexible and the challenges to be answered and the tasks to be performed can be very varied, and that is good. The sharing and transfer part is also important. In recent years digital tools have helped a lot in this regard, and the operational groups in particular, and the whole RuralCat program plays a key role in the transfer of innovation in the sector. More than 250 stakeholders from the ecosystem have participated on project presentation days.

The most critical part is the administrative justification. Unfortunately, this is not just a problem for operational groups, but for all projects funded by the Administration. We know that the Department is working hard to facilitate this, but current regulations make it very cumbersome. We increasingly come across companies that do not want to opt for public financing precisely because of this issue.

In recent years digital tools have helped a lot in this regard, and the operational groups in particular, and the whole RuralCat programme, play a key role in the transfer of innovation in the sector.

Do you think that this type of projects are a good tool to encourage innovation and knowledge transfer in the sector?

The choice of members is key to a project's success. For us it is very important that the potential users, winegrowers and wineries, are as diverse as possible so that different experiences are considered. Incorporating technology supply companies that can take advantage of everything that the technology or research centre has generated in the project is also very important, as it guarantees the replicability and scalability of the work done. All this makes the model a success and every year more and more companies want to participate.

The choice of members is key to a project's success.

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

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