Implementation of an agricultural and livestock (pig) production system linked to nutritional strategies with sorghum and rye varieties adapted to climate change (AGRONUTRICC)

Summary

This project aims to explore the potential environmental benefits of reformulating feed or compounds for the pig farming sector by replacing some of the main cereals used (maize, wheat and barley) with certain varieties of rye and sorghum, which have lower water requirements and enable more efficient and economical crop management. The objective, therefore, is to verify whether these varieties of cereals, better adapted to harsher environmental conditions caused by the progressive climate change that the planet is experiencing, can be a valid alternative for reformulating the feed used in the pig farming sector. The tests carried out will help determine whether these new reformulations contribute to ensuring a balanced and adequate nutritional diet that is beneficial for the health of the animals, while also revealing what changes this would lead to in terms of the carbon footprint and, therefore, their contribution to reducing greenhouse gas emissions that contribute to climate change.

Given the cross-cutting approach of the project towards the whole chain of economic sectors that form the basis of the pork sector production chain (cereal farming, feed manufacturers and livestock farms), it can be concluded that this project contributes to **promoting the productivity of agri-food companies in the agricultural, raw material processing and livestock sectors,** the **sustainable use of resources** and the **fight against climate change** through the reduction of greenhouse gas emissions.

Objectives

The **main objective** of the AGRONUTRICC project is **to work towards an efficient and sustainable pig production system that guarantees animal health and welfare, linked to crop production adapted to climate change conditions and with the use of improved varieties that enable documentation and generation of knowledge on the reduction of greenhouse gas emissions in current pig production systems**.

The idea is to achieve this objective through cooperation and complicity between production systems (crop and livestock) in order to integrate local cereal production as a sustainable energy source for pig production. The execution of the AGRONUTRICC project will provide data on the possibility of integrating the local production of new generation cereals with pig production to reduce the carbon footprint and thus improve the sustainability of the pig sector.

To achieve this general objective, the AGRONUTRICC project will address the following specific technical objectives:

1) Study the carbon footprint associated with the production of new cereal varieties (adapted to the new climate conditions), which have the potential to improve the health and efficiency of pig production, produced locally in different locations in Catalonia.
2) Study the nutritional value and applicability of new cereals as a source of energy in growing, fattening and finishing diets for pigs (up to slaughter).
3) Study the digestibility and nutrient utilisation of the new varieties used in comparison with cereals traditionally used in the sector.
4) Study the impact of the new cereal varieties grown and used on gastrointestinal functionality,

metabolites of digestion and fermentation processes and animal health.

5) Use near infrared spectrometry (NIRS) calibration models to predict yield, nutritional value, digestible energy, amino acids and other nutrients and metabolisable energy and protein values for the different cereals under study.

6) Implement the concept of multi-target formulation to assess the impact of new cereal varieties to meet nutritional needs at minimum cost and minimising environmental impact.

7) Establish and document through an integrative study between local production of cereals adapted to the new climatic conditions and pig production. Study how the incorporation of these new varieties in pig diets will influence the carbon footprint of the formula and of the meat produced, integrating the impact of productivity in the field under local conditions in our country, the use of pesticides, nitrogen (N) and CO_2 loads and the productive efficiency of both sectors (agricultural and livestock).

Description of the actions carried out in the project

The AGRONUTRICC project involves an implementation plan of four Research and Innovation activities. All the activities proposed by the AGRONUTRICC project are inter-linked to ensure that the information generated from this interaction between the field, the feed factory and the farm feeds back into decision-making, allows the corresponding life cycle calculations to be carried out and enables conclusions and recommendations to be drawn for the beneficiary companies and for the sector based on real field conditions supervised and executed with rigour and scientific method. All activities will be launched from the start to take advantage of the duration of the project, however, part of the activities 2, 3 and 4 will be conditioned by the agricultural part, which will determine the timeline of the project. To help get the project started, some of the activities will use existing data and models and implement the results generated by the project at a later stage when they become available as the activities are executed (e.g. initial selection of existing cereal varieties, analysis and results of previous analysis for decision making, simulations of multi-target formulations, simulations of production yields and expected duration of fattening periods). This ensures that if one activity is delayed, the schedule tasks for the rest of the project will not be affected.

In **activity 1** the crop production systems (the agricultural part) will be implemented first by selecting and comparing varieties of hybrid rye and white sorghum and subsequently by multiplying the selected varieties in sufficient volume for the production of experimental feed and execution of the experimental trials using fattening pigs to be carried out in activity 2. Activity 1 should provide the necessary and objective information to be able to calculate the environmental impact (in terms of CO_2eq footprint) associated with the production of the new cereal varieties (hybrid rye and white sorghum) compared to wheat and maize varieties grown under the same conditions and cultivation area.

Activity 2 will study how new cereal varieties (hybrid rye and white sorghum) can be used as an energy source to replace wheat or maize in diets for growing and fattening pigs with special emphasis on health and production efficiency and will also provide the necessary information for calculating the environmental impact associated with pig production. This activity includes the contribution of the feed manufacturing process from the factory (process efficiency and feed quality).

Activity 3 will study the impact of replacing wheat or maize as an energy source for growing and finishing diets with new cereal varieties (hybrid rye or white sorghum) on carcass characteristics and carcass quality.

Activity 4, which will be carried out continuously from the beginning to the end of the project, will calculate and further refine the calculation of the carbon footprint across the board from the production and cultivation of the cereals, through the slaughterhouse to the feed factory and the farm so that the execution of activities 1, 2 and 3 will ultimately generate the necessary data to objectively calculate the

life cycle analysis of today's production and of the sector.

Activity 5 includes the tasks proposed within the plan for the dissemination and transfer of project results.

Final results and practical recommendations

The results based on the selection of improved cereal varieties will be related to the assessment of the parameters that condition decision-making in terms of productive yields in the field and nutritional quality per unit of CO_2eq and water footprint. This will enable the farmer to choose the most productive and at the same time most useful variety to meet the needs of feed manufacturers to ensure a high-quality energy source, with associated functionality both in terms of efficiency in the manufacturing process, enteric efficiency during the on-farm production process and animal health which ultimately determine the environmental impact from field to meat. The results obtained should help generate applied and applicable knowledge at the sector level for decision making that will make it possible to take advantage of field work as a strategy to mitigate the impact of the formula on the CO_2 footprint and animal health, not only at company level but also at sector level, and indirectly promote a coming together and a need to link pig (livestock) production with agricultural production dedicated to cereal cultivation in order to tackle climate change. The hope is that the new selected varieties, due to their higher efficiency in water and fertiliser requirements for proper production and yield, could be a sustainable and viable energy source to reduce the CO_2eq impact or load in pork formulations.

The expected results of the implementation of activity 2 would be that the selected varieties of both hybrid rye and white sorghum would be able to replace wheat or maize in pig diets during the growing and fattening phases (as proof of concept) without compromising production efficiency and show improvements in terms of health derived from the functionality of the fibrous fraction in the case of hybrid rye on intestinal health while also mitigating the potential challenge of mycotoxin concentration associated with maize in case of being replaced by a mycotoxin-free cereal such as white sorghum. Despite the lower energy concentration of the new cereals, the expected high digestibility associated with a lower degree of challenge may allow a reduction in maintenance requirements that will allow satisfactory results to be obtained from the substitution of the new cereal varieties. This will promote a link with agricultural production, as it would encourage the cultivation of cereal varieties that are more productive but at the same time better adapted to current climate change conditions.

The expected results of the implementation of activity 3 would be that the selected varieties of both hybrid rye and white sorghum would be able to replace wheat or maize in pig diets during the growing and fattening phases (as proof of concept) without compromising objectively significant effects on carcass yield and carcass quality, as well as the characterisation of prime cuts according to the established quality standards depending on the destination of the pieces and the genetic cross used (finishing male).

The expected results of the implementation of activity 4 would be that the selected varieties of both hybrid rye and white sorghum would show potential for improvement in terms of environmental impact at different levels, reduction of associated CO_2 eq load per kg of cereal, at the level of multi-target formulation allowing sustainable, economical and nutritionally viable diets, improved health and enteric efficiency of pig production. Generate documentation, data and objective calculations on the current situation in the Catalan production sector that will enable decisions to be made on future strategies and allow an assessment of the viability of reconciling the pig sector with the land as a tool with dual impact (sustainability and rural development in the face of a climate change scenario).

Leader of the Operational Group

ORGANISATION: GRANGES TERRAGRISA, SL

Coordinator of the Operational Group

ORGANISATION: GRANGES TERRAGRISA, SL

Other members of the Operational Group (grant recipients)

ORGANISATION: ESPORC. SA

ORGANISATION: SANTIAGO CAUDEVILLA JUSTRIBO

Other members of the Operational Group (not recipients of the grant)

ORGANISATION: AUTONOMOUS UNIVERSITY OF BARCELONA

Subject area(s) of application

☒	Agricultural production system
☒	Agricultural practice
☐	Agricultural equipment and machinery
☒	Livestock farming and animal welfare
☐	Vegetable production and horticulture
☐	Landscape / Territorial management
☐	Pest and disease control
☐	Fertilisation and nutrient management
☐	Soil management
☐	Genetic resources
☐	Forestry
☐	Water management
☒	Climate and Climate Change
☐	Energy management
☐	Waste and by-product management
☐	Biodiversity and environmental management
☒	Food quality/processing and nutrition
☐	Supply chain, marketing and consumption
☐	Competitiveness and agricultural and forestry diversification
☐	General

Geographical area(s) of application

PROVINCE(S)	REGION(S)
BARCELONA	OSONA
LLEIDA	SEGRIÀ
GIRONA	SELVA

Dissemination of the project (publications, conferences, multimedia, etc.)

The dissemination of the knowledge generated by the AGRONUTRICC project will be carried out as follows:

- Key scientific results will be disseminated through scientific publications, presentations at international conferences and workshops with the agreement of all beneficiaries.
- Popular science articles will be disseminated through popular magazines aimed at seed producers, feed manufacturers and pig producers.

- Participation in Technical Pig Farming Seminars at the UAB.
- Use of the dissemination resources available to each of the companies (personalised emails to customers, website, social media, conventions, catalogues, commercial documentation, newsletters, etc.).
- Presentation of new developments and results of the project at fairs, conventions and specific seminars in the sector.
- An informative video of the project will be produced.

Project website

https://sniba.es/?lang=ca

More information on the project

PROJECT DATES	TOTAL BUDGET	
Starting date: July 2021	**Total budget:**	€215,428.46
	DACC funding:	€99,625.50
Current status: Under way	**EU funding:**	€75,156.08
	Own funding:	€40,646.88

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Order ARP/113/2021 of 20 May, approving the regulatory bases for grants for cooperation for innovation by promoting the creation of European Association for Innovation operational groups in the areas of agricultural productivity and sustainability and the execution of innovative pilot projects by those groups, and Resolution ACC/1660/2021, of 27 May, announcing the call for the grant.

Generalitat de Catalunya
Departament d'Agricultura, Ramaderia, Pesca i Alimentació

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