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New alternatives to milk from pulses: digestibility and bioactivity

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Background

There is a high demand for milk substitutes other than soy beverages from health to ethic and sustainability reasons. However, plant based current offers are essentially poor in protein content (less than 1.5% against the 3.5% in milk). The choice is the use of pulses with high protein content on seeds. Beany flavor may hamper their acceptance, but this is easily mitigated or overcome by current processing technology, which also enhances digestibility and beverage nutritional quality.

Objectives

The objective is to evaluate the impact of processing to keep nutritional characteristics of beverages and achieve its best digestibility.

Methodology

Two different pulse seeds (*Lupinus albus L.* and *Cicer arietinum L.*) were used to produce beverages with 10% (w/v) of total dry seeds. Seeds were soaked and cooked and liquids discarded, milled into very small particles and coarsely sieved (Fig 1). To overcome starch gelatinization in chickpea beverage, two enzymes were used during beverage production and viscosity was measured. All beverages were submitted to static in vitro digestion and analyzed physicochemically. Lupin and chickpea beverages were submitted to gelatinolytic activity quantification and zymographic analysis. ANOVA was used to assess significant differences between samples at a significance level of 95% ($p < 0.05$).

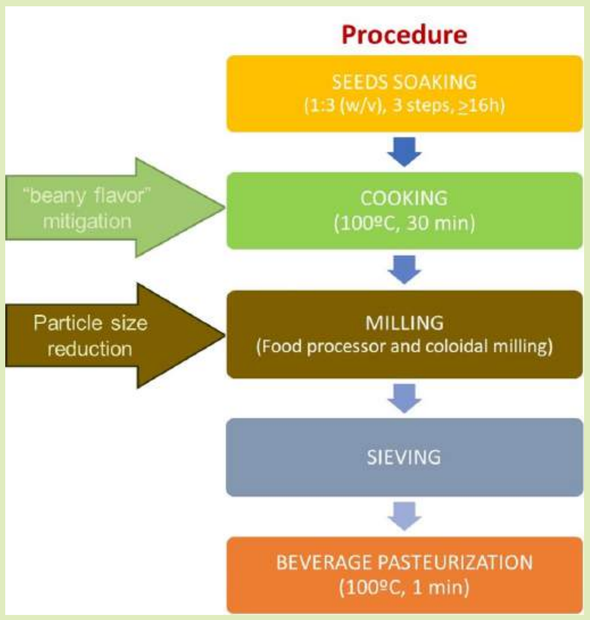

Figure 1. Beverage´s fabrication procedure

Table 1. Comparison of the nutritional composition of beverages. Values are represented as mean ± standard deviation. (C – chickpea; L – lupin; α – alpha-amylase; a – amyloglucosidase)

Beverage	Protein (% w/v)	Carbohydrates (% w/v)	Starch (% w/v)	Glucose (% w/v)	Glycemic index (%)	Phytic acid (% w/v) (mg/g)
C	3.75± 0.19	90.12± 3.09	13.91± 2.18	4.49	50.3	0.78 ± 0.01 (7.11)
L	4.69± 0.29	32.69± 9.87	0.08± 0.01	0.65	42.6	0.83 ± 0.00 (7.52)
L + C	4.18± 0.10	53.56± 5.92	2.33± 0.07	2.85	48.7	0.84 ± 0.00 (7.65)
C α	3.53± 0.11	76.18± 8.55	13.46± 0.70	4.94	50.0	0.79 ± 0.00 (7.20)
C α + a	3.65± 0.17	52.88± 5.44	13.22± 0.08	8.67	51.3	0.79 ± 0.00 (7.23)
C a	3.61± 0.20	52.47± 6.45	12.71± 1.01	5.20	49.5	0.80 ± 0.00 (7.30)

Table 2. Protein and phytic acid contents after *in vitro* digestion of pulse based beverages. Values are represented as mean ± standard deviation. (C – chickpea; L – lupin; α – alpha-amylase; a – amyloglucosidase)

Digesta	Protein (% w/v)	Phytic acid (% w/v) (mg/g)
C	2.53 ± 0.18	0.062 ± 0.003 (0.59)
L	2.49 ± 0.11	0.064 ± 0.001 (0.61)
L + C	2.39 ± 0.15	0.061 ± 0.001 (0.58)
C α	2.29 ± 0.13	0.062 ± 0.006 (0.59)
C α + a	2.56 ± 0.17	0.063 ± 0.001 (0.60)
C a	2.99 ± 0.12	0.063 ± 0.003 (0.60)

Results

Chickpea-based beverages showed a protein content around 3.6% (w/v) and lupin beverage 4.7% (w/v). The starch hydrolysis of chickpea beverage with both enzymes showed a small increase on glycemic index (51.3% compared to 50%). The lupin beverage presented the lowest glycemic index (42.6%) and the lowest starch content (0.08% w/v) (Table 1). The comparison between protein and phytic acid results of digesta and respective beverages (Table 2), showed a decrease for every samples, as expected, demonstrating their high digestibility. The lupin digesta evidenced significant higher contents in Ca, Mg, P, Mn, S and Cu when compared to chickpea. Both phytic acid and lectins did not inhibited digestive enzymes.

Conclusions

Pulse beverages are as good sources of protein as cow milk, and presented low-glycemic index. There was evidence of protein hydrolysis by in vitro digestion and bioavailability of minerals. In addition, besides being highly digestable, lupin and chickpea beverage evidenced anti-inflammatory and anti-carcinogenic activities.

ACKNOWLEDGEMNTS: This work was supported by the FCT Project PTDC/BAA-AGR/28370/2017: "Leite de proteína vegetal a partir de leguminosas europeias com potencial bioativo" and through the research unit UID/AGR/04129/LEAF.

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Chorume acidificado, uma solução sustentável para fertilização em sementeira direta

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Instituto Federal de São Paulo

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1. Introdução

Os efeitos adversos da uso do nitrogênio (N) na agricultura estão a estabelecer desafios globais que relacionam-se a outros como o crescimento populacional, mudanças climáticas e degradação dos solos. Manejar o solo de forma sustentável nunca foi tão importante e isso é possível através de práticas, tais como a sementeira direta e a fertilização orgânica, que promovem a melhoria das funções do solo, possibilitando serviços ecossistêmicos e biodiversidade (FAO, 2021).

2. Material e Métodos

Dois ensaios foram realizados, em vasos, no Instituto Superior de Agronomia, em Lisboa para avaliar os efeitos da aplicação de chorume acidificado de vacas leiteiras, a pH 5,5, aplicado sobre restolhos de trigo (300 g m^{-2}) sem incorporação ao solo, tal como ocorre em sementeira direta. Os fertilizantes estudados foram Chorume Bruto (CB), Chorume Acidificado (CA) e Sulfato de Amônio (SA). No primeiro ensaio, foram avaliadas as emissões de N_2O, a absorção de N e a produção de matéria seca (MS) do azevém após 202 dias. No segundo, avaliou-se as emissões de NH_3 .

3. Resultados e discussão

Produtividade de azevém: CA ≈ SA ≈ CB (Tabela 1). Emissão de N_2O: SA ≥ CA ≥ CB . O menor valor obtido em CB, é possivelmente justificado pela perda acentuada de N via volatilização do NH_3 (Tabela 1; Figura 1). Equivalência ao Fertilizante Mineral (EFM): CA > CB. Emissões totais de NH_3 : CB > CA > SA ($p < 0,05$).

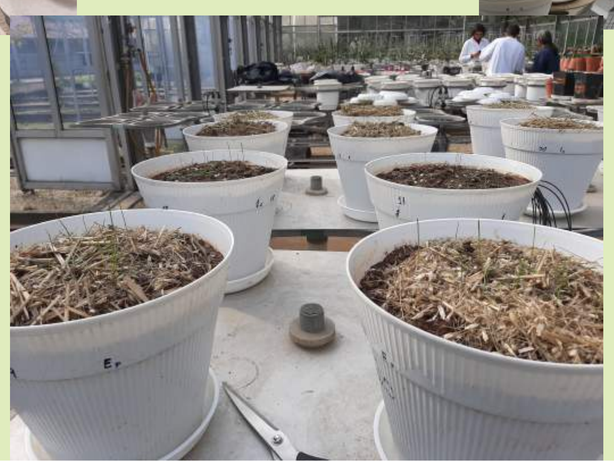
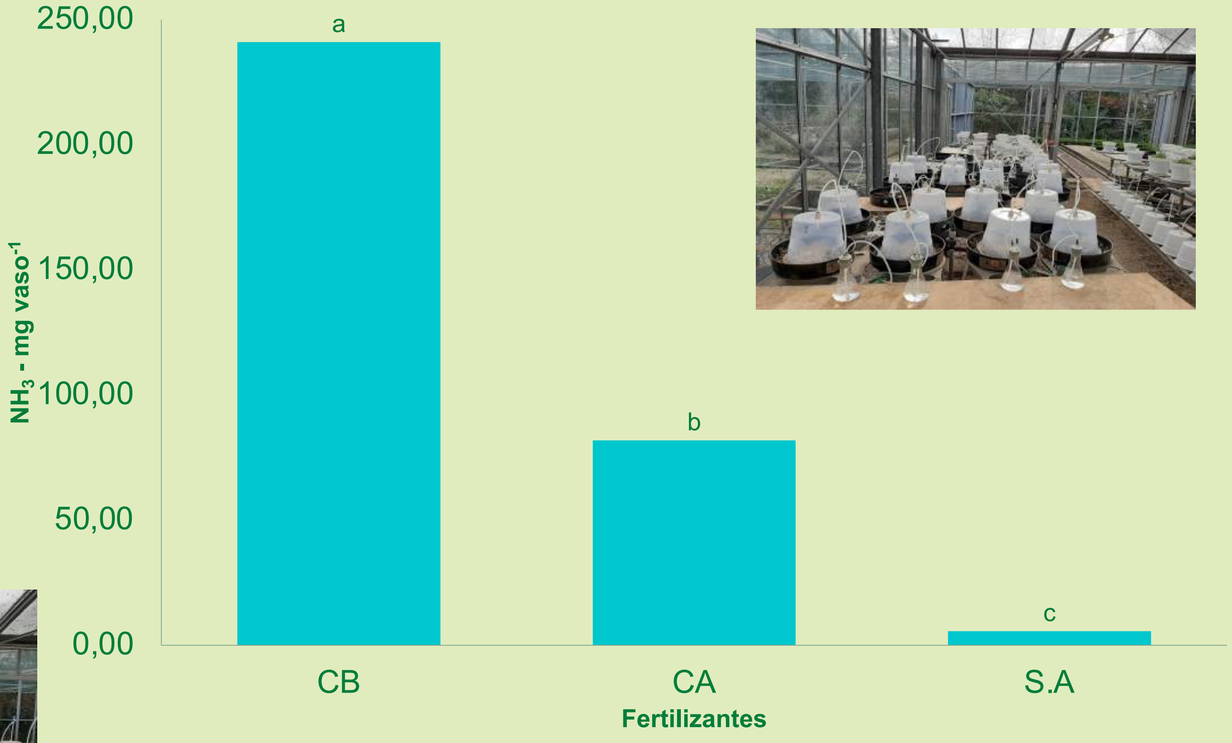


Tabela 1: Produtividade, emissões cumulativas de N_2O e equivalência ao fertilizante mineral (EFM).

Fertilizante	Produtividade g $vaso^{-1}$	N_2O mg $vaso^{-1}$	EFM %
Chorume Bruto	19.86	16.17 b	80.48 b
Chorume Acidificado	24.52	23.79 ab	94,56 a
Sulfato de Amônio	21.82	28.08 a	-

Figura 1: Emissões totais de NH_3 dos fertilizantes Chorume bruto (CB), Chorume acidificado (CA) e Sulfato de amônio (SA)



4. Conclusões

A acidificação do chorume de vacas leiteiras possibilitou uma produtividade semelhante ao SA e alcançou EFM superior ao do CB. CA reduziu a emissão total de NH_3 em relação ao CB. Conclui-se que o CA é uma solução sustentável para a fertilização nitrogenada em sementeira direta.

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Interpolation of soil apparent electrical conductivity data: sampling density

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INTRODUCTION Soil apparent electrical conductivity (ECa) sensors are now widely used to estimate some physical and chemical soil parameters. To be able to provide a medium more adjusted to the needs of plants and to produce more and better food, in a sustainable way, it is important that soil sampling mirrors its characteristics. The main objective of this work was to compare two sampling densities of soil apparent electrical conductivity (Veris 3150 sensor) through two interpolation methods, the inverse distance weighted (IDW) and ordinary kriging (KO).

MATERIALS AND METHODS

Place: Quinta do Quinto (18 ha) – Escola Superior Agrária
Veris 3150: Soil ECa (0-30 cm)
Filtering process: Blackmore & Moore (1999)
Interpolation: IDW and KO (ArcMap)
Densities: high density (100%) and low density (2%)

RESULTS

- **High density ECa data**: normal distribution (Kolmogorov-Smirnov, Lilliefors correction).
- **Low density ECa data**: slight asymmetry (<1) (Kolmogorov-Smirnov, Lilliefors correction); normal distribution (Shapiro-Wilk).

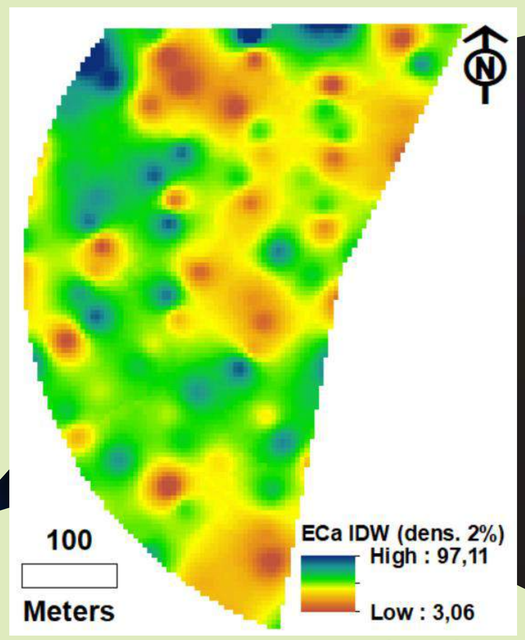

Fig.1 ECa Low Density (IDW)

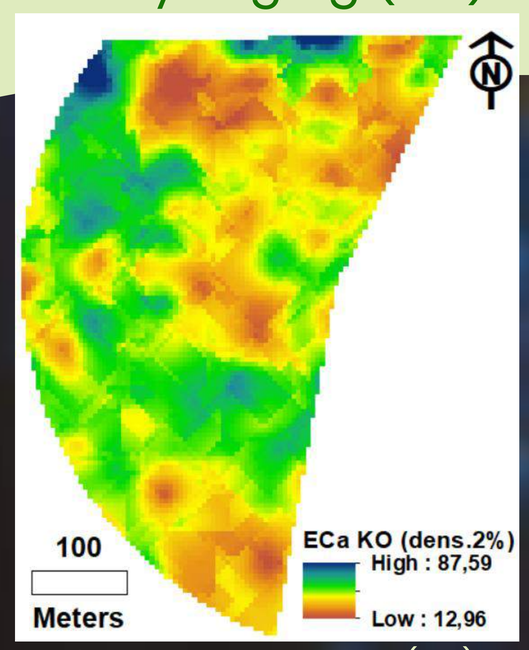

Fig.2 ECa Low Density (KO)

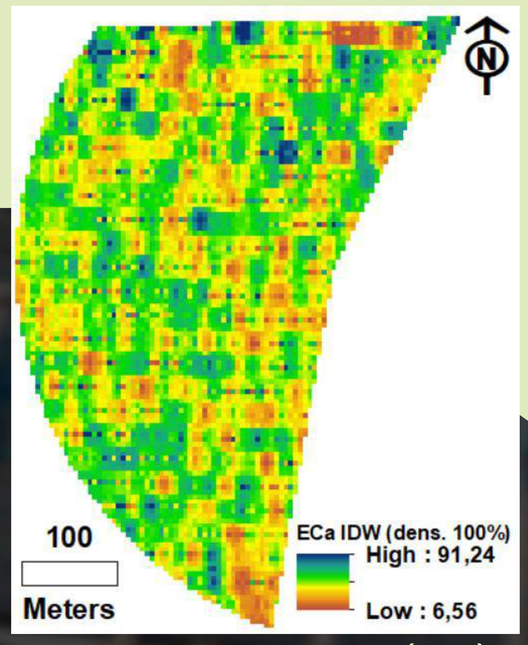

Fig.3 ECa High Density (IDW)

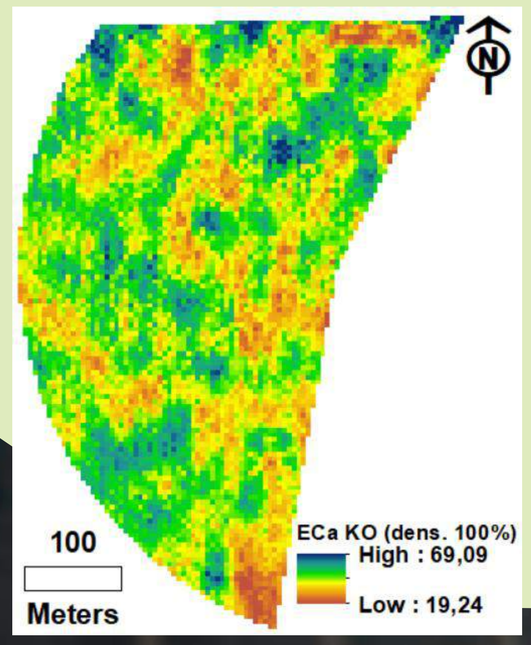

Fig.4 ECa High Density (KO)

- **High density ECa data** - KO: low dispersion of data (CV=16%, fig.3, fig.4); **Low density ECa data** - IDW: medium dispersion of data (CV = 30%, fig.1, fig.2).
- **High density ECa data**: interpolation of ECa showed no significant differences (0.05) between interpolation by IDW and KO (T-test, testing the null hypothesis of equality of means).
- **Low density ECa data**: interpolation of ECa showed no significant differences (0.05) between interpolation by IDW and KO (T-test, testing the null hypothesis of equality of means).
- Comparison of **low density with high density of ECa** data: significant differences (0.05) were observed between densities in both IDW and KO methods.

CONCLUSIONS

This research work showed that: **i)** when the density of sampled values is high, both methods showed similar results; **ii)** the differences were significant between high and low densities regardless of the method; **iii)** the ECa survey, usually performed at high density, is important in defining zones in the soil with common physical characteristics and in supporting targeted soil sampling.

[IPSantarém] INSTITUTO POLITÉCNICO DE SANTARÉM

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Millets and their Crop Wild Relative in Cabo Verde

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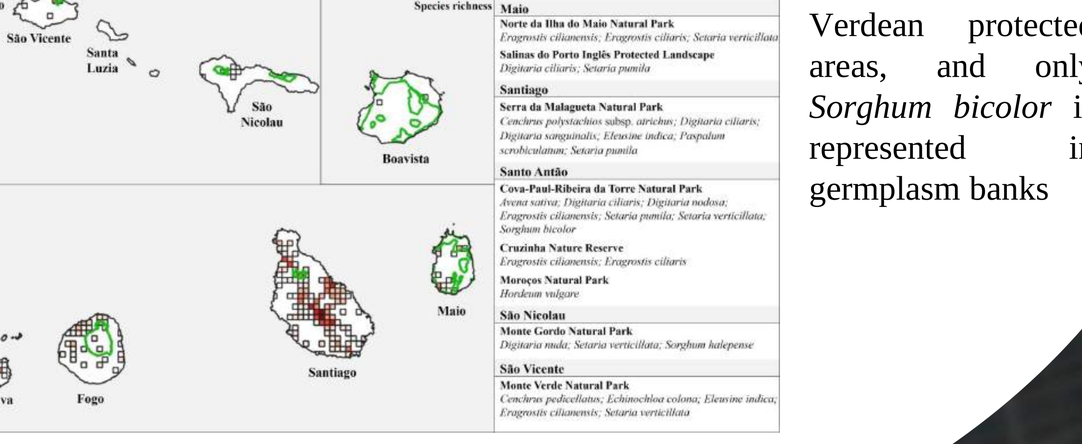
Introduction

Poaceae family, one of the major plant group in the world are well adapted to a wide range of habitats, and particularly suited to arid environments. The importance of this family is well known, not only for the economic value of several crops to humankind but also for their Crop Wild Relatives (CWR), essential to crop improvement.

Aims

The value of the Cabo Verde's Poaceae for agrobiodiversity is highlighted through, (A) identifying the grass used for direct consumption, as well as their CWR, (B) evaluating the importance of the CWR for crop improvement, (C) and assessing the need of special conservation measures in the archipelago.



A. The 26 Poaceae CWR identified in Cabo Verde and their Priority for collecting and conserving. Priority categories: green – highest, grey – medium, blue – low.

B. Comparison of the importance of the 14 Poaceae crops studied and their CWR in Cabo Verde. The Importance Score concerns the food supply and agricultural production metrics of the crops and the mean Priority Score represents the nine criteria used as a proxy to prioritize the CWR (for details see Rocha et al., 2021). The size of the circles indicates the number of CWR taxa per crop. The colours indicate the native distribution of the crop

C. Most CWR biodiversity hotspots are outside Cabo Verdean protected areas, and only *Sorghum bicolor* is represented in germplasm banks

Conclusions

The study highlights the diversity of CWR and the need to conserve these unique plant genetic resources existing in Cabo Verde, that can be crucial to food security and sustainable development of the archipelago, in view of the drought scenarios that cyclically affect this islands.

Funding: FCT and Aga Khan Development Network (AKDN) for funding the project CVAgrobiodiversity/333111699

More information: Rocha V et al. (2021) Cabo Verde's Poaceae flora: a reservoir of Crop Wild Relatives diversity for crop improvement. Frontiers in Plant Science. doi: 10.3389/fpls.2021.630217

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A step towards the production of manure-based fertilizers

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Purpose

The main aim of this work is to produce a **manure-based fertilizer**, by blending non-treated or treated manures, with a **known ratio of N:P**. Beside contributing to a circular economy, It will **enhance the fertilizer value** of manures, by improving their usability, providing them in a more adequate and **easy handling** form **to farmers**, reducing, at the same time, the environmental problems associated to their use.

1st Stage

Study the **manures available** in the **Portuguese reality** and which treatment could be used.

Assess the **effect** of different **animal species** and **treatment** on the **nutrients ratio and availability**.

2st Stage

Analysed the possible blend in two scenarios:

Farm Scale: Blend the manure with a mineral fertilizer to obtain the intended ratio of N:P.

Central-Plan: Blend the manures between them to obtain the intended ratio of N:P.

How to test the blend?

In a **first step** teste more possible blends, in order to have a full understanding of the nutrients cycle the following experiments will be conducted:

Aerobic Incubation

Green House Gases Emissions

Leaching

In a **second step** test the best blends of both scenarios in a **plot trial to determine the agronomic value**.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773682.

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DAIRY-4-FUTURE
PROMOVER INOVAÇÕES PARA UM SETOR LEITEIRO MAIS RESILIENTE NO ESPAÇO ATLÂNTICO

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CONTEXTUALIZAÇÃO:

O setor leiteiro no Espaço Atlântico enfrenta atualmente vários desafios:
· Melhorar o custo-eficiência e a resiliência económica das explorações;
· Promover uma utilização dos recursos de forma mais eficiente (alimentação, água, energia);
· Reduzir o impacto ambiental;
· Fortalecer a atratividade do setor leiteiro.

O projeto Dairy-4-Future tem como **OBJETIVOS CENTRAIS:**

- aumentar a competitividade, a sustentabilidade e a resiliência das explorações leiteiras;
- desenvolver sistemas produtivos inovadores e eficientes;
- melhorar a cooperação entre o setor público, privado e académico para alavancar a colaboração transnacional.

OBJETIVOS OPERACIONAIS:

- Análise do desempenho económico, social e ambiental de explorações leiteiras do espaço Atlântico, de forma a identificar sistemas de produção leiteiro inovadores e mais eficientes;
- Avaliar os serviços de ecossistemas oferecidos pela produção leiteira;
- Identificar, estudar e disseminar casos de sucesso ao longo da cadeia de valor;
- Testar e partilhar ideias inovadoras e sistemas leiteiros inovadores;
- Fazer recomendações e propor medidas de incentivo às políticas regionais
- Preparar o quadro para uma maior cooperação entre as partes interessadas.

Para alcançar os seus objetivos, os parceiros do projeto pretendem cooperar com todos os intervenientes envolvidos no setor leiteiro, estimulando a interligação entre os consumidores, as empresas e centros de investigação e promovendo a cooperação transnacional..

UM PROJETO EUROPEU (2018-2021), DA ESCÓCIA AOS AÇORES…

COORDENADOR:
Institut de l'Elevage (França)

11 PARCEIROS:
– SRUC (Escócia)
– CAFRE (Irlanda do Norte)
– Teagasc (Irlanda)
– AHDB (Pais de Gales e Inglaterra)
– Institut de l'Elevage (França)
– CRAB (Bretanha - França)
– Inra Lusignan (Aquitaine - França)
– Neiker (País Basco)
– CIAM/INGACAL (Galiza)
– UTAD (Norte de Portugal)
– ISA (Sul de Portugal e Açores) com a colaboração da Milkpoint Portugal

21 parceiros associados: 4 portugueses

Associação Agrícola da Ilha Terceira

5 países | **11** parceiros técnicos | **>100** explorações piloto
12 regiões do Espaço Atlântico | **21** parceiros associados | **10** explorações experimentais

OBJETIVO Ter um visão clara do setor leiteiro no Espaço Atântico

- Análise SWOT à produção leiteira, à indústria do leite e aos mercados
- Valorização dos serviços prestados
- Identificar fatores de sucesso na cadeia de valor
- Perspetivar o crescimento do setor leiteiro até 2025

OBJETIVO Promover a resiliência económica do setor leiteiro melhorando os recursos e a eficiência

- Avaliação das melhores práticas (recursos-eficiência) em 10 explorações experimentais
- Avaliação da eficiência na utilização dos recursos em mais de 100 explorações piloto

1 ANALIZAR O SETOR LEITEIRO NO ESPAÇO ATLÂNTICO
2 PROMOVER A RESILIÊNCIA ECONÓMICA
3 MELHORAR O USO EFICIENTE DOS RECURSOS
4 PROPOR SISTEMAS SUSTENTÁVEIS PARA O FUTURO

OBJETIVO Melhorar a economia e os resultados ambientais, nas explorações do Espaço Atlântico, através de práticas inovadoras

- Avaliação económica de mais de 100 explorações piloto
- Identificar fatores externos que afetam as explorações leiteiras
- Troca de conhecimento e ferramentas, comunicação e medição de desempenho para melhorar a resiliência económica das explorações leiteiras

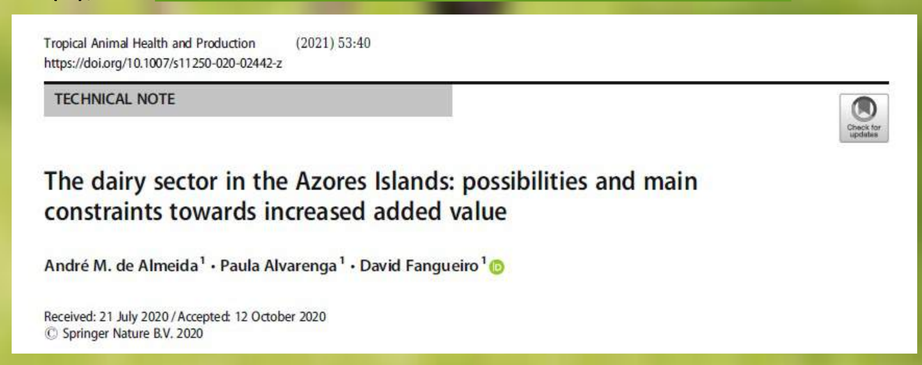
OBJETIVO Encontrar o equilíbrio perfeito entre rentabilidade, uso eficiente dos recursos e resultados ambientais

- Sistemas modelo para 2020/2025
- Mapas para um futuro sustentável do setor leiteiro
- Indicadores que orientem as explorações leiteiras e os produtos para as exigências do mercado

OBJETIVOS:
Reduzir os **custos de produção** nas explorações leiteiras em **10%** e a **pegada de carbono** do leite em **20%**

Publicações:

Almeida, A.M., Alvarenga, P., Fangueiro, D. (2021). The dairy sector in the Azores Islands: possibilities and main constraints towards increased added value. Tropical Animal Health and Production, 53(1), 40. https://doi.org/10.1007/s11250-020-02442-z


Tropical Animal Health and Production (2021) 53:40
https://doi.org/10.1007/s11250-020-02442-z

TECHNICAL NOTE

The dairy sector in the Azores Islands: possibilities and main constraints towards increased added value

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Dairy 4 future

Interreg Atlantic Area
European Regional Development Fund

www.dairy4future.eu

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HORTINF
2018-2021

Grupos Operacionais PDR2020 101-030857

The Project aims to develop and implement technologies for SUSTAINABLE WEED MANAGEMENT

- **Identification of the flora present in hortoindustrial crops – weed species and parasitic plants – and improvement of technologies for their control**
- **Diversification of sustainable weed control strategies such as stale seedbed, soil tillage, cover cropping and bioherbicides**

Sociedade Agrícola de S. João de Brito, S.A | António Maria Graço, Lda | João Carlos Moisés | nop

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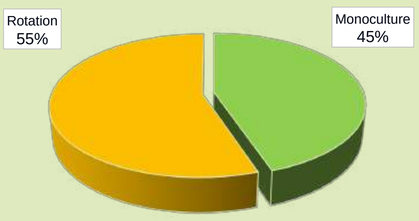
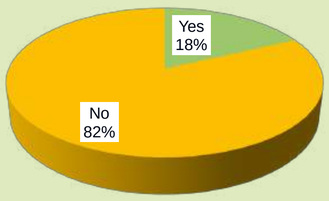
INTERVIEW SURVEY TO FARMERS

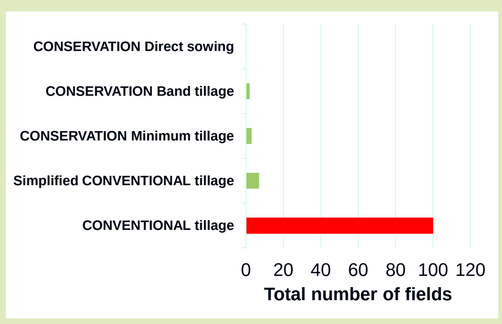
CROPPING SYSTEM



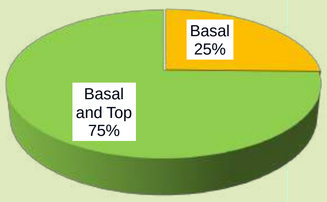
COVER CROPPING
Yes/*Lolium* rigidum
No/ Fallow



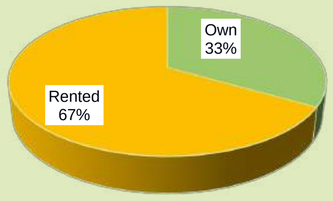
TILLAGE PRACTICES

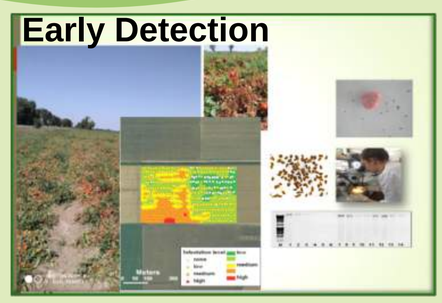


FERTILIZATION



LAND OWNERSHIP



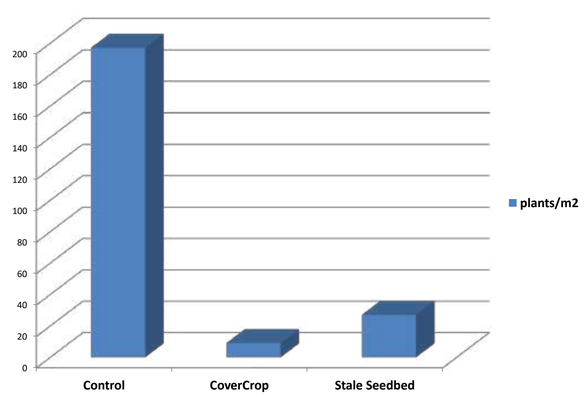


WEED COMMUNITY DIVERSITY

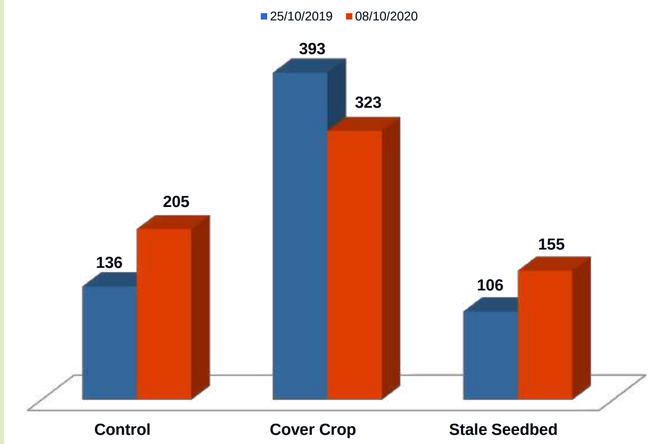
41 weed species
31 botanical families (*Asteraceae, Poaceae, Amaranthaceae)*
Annual plants predominates (80 %)
over perennial ones (12 %)

WEED MANAGEMENT STRATEGY

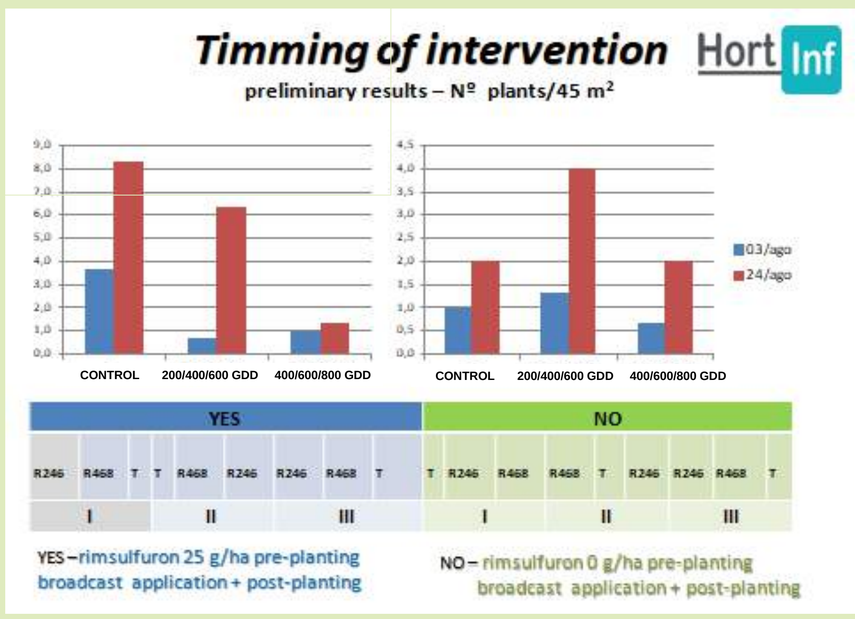
TECHNOLOGY	REGION	CROP	WEEDS
Cover cropping *(consociation)*	Golegã	Maize	Main weed flora
Bioherbicide *(pelargonic acid)*	Golegã	Maize	Nutsedges (*Cyperus* spp.)
Timming of intervention *(rimsulfuron)*	Lezíria Vila Franca de Xira	Tomato	Broomrape (*Phelipanche ramosa*)



WEED DENSITY (Plants/m²)
S. JOÃO DE BRITO - GOLEGÃ



YELLOW NUTSEDGE TUBERS DENSITY (0,25 m²)
CASAL DAS FREIRAS - GOLEGÃ



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IPSANTAREM_26, 27 MAY 2021

Portuguese case study in recirculative hidroponic system

TOMA INOV

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Abstract

To reach the recognition of Oeste region, as a distinctive territory for fresh, and sensorial consistent, quality tomato production, TomatInov Project develops high quality tomato while improves resource use efficiency, namely of water and fertilizers, trough the recirculation of treated drainage from greenhouses. A case study was monitored, and the reuse of water and nutrients was achieved with success. High rates of nutrients were recovered in some periods and the disinfection method proved to be efficient as no disease was disseminated in the process.

Keywords: Circular economy, Horticultural practices, *Solanum lycopersicum*, Sustainability, TomatInov

Methods and results

In soilless cultivation, it is often necessary to use surplus nutrient solution in order to overcome the inequalities related to the distribution system, which makes the reuse of drainage an effective way to optimize the use of resources in these circumstances (Costa *et al.*, 2020). During TomatInov project, the recirculation system in place (Fig. 1.) was monitored for water quality (microbiologic, physic and chemical parameters) and, in some periods of the cycle, up to 70% of nitrate and 50% of phosphorus were recovered. Although good results were obtained regarding the potential nutrient recovery from the drainage, and no inconvenient was found, regarding disease transmission, some improvements were suggested (Fig. 2.).

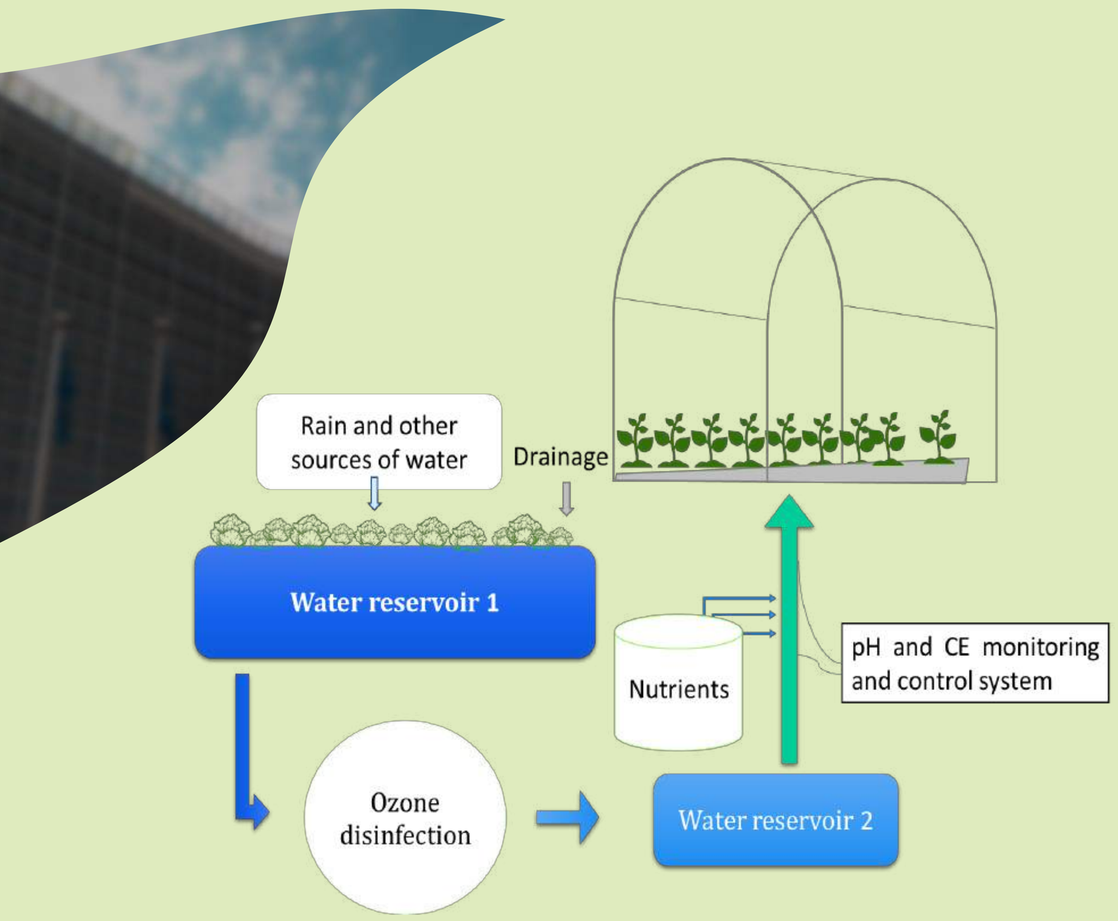

Fig. 1. Schematic representation of the drainage reuse system

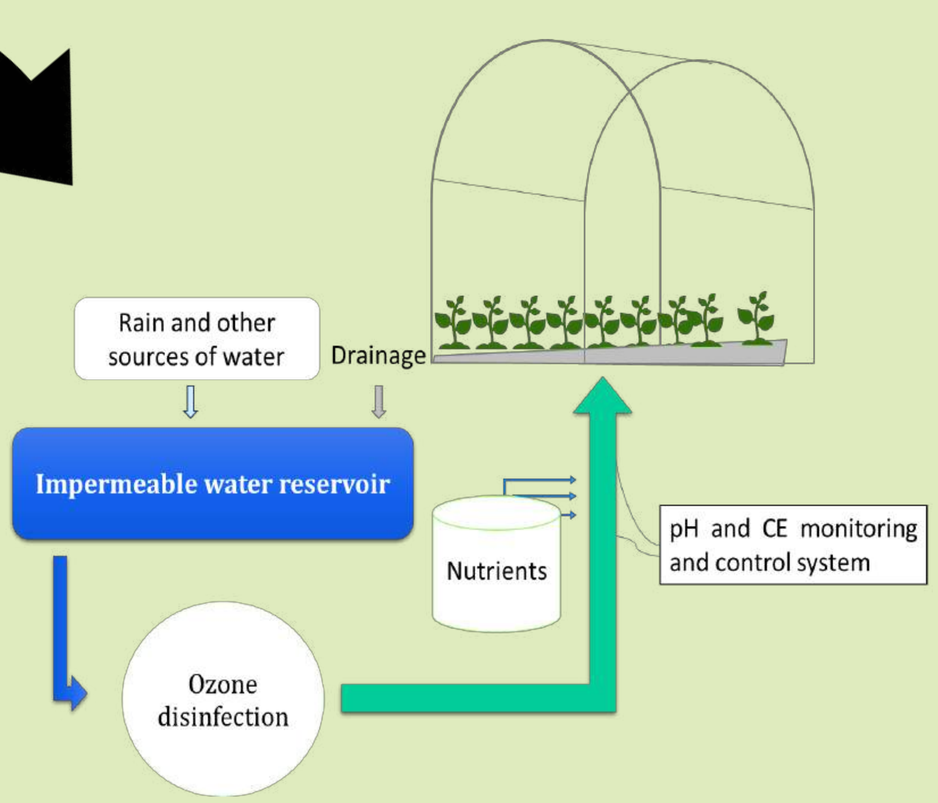

Fig. 2. Schematic representation of the proposed closed system

Conclusions

Reuse drainage from greenhouses to formulate new nutrient solution is a viable way of reduce nutrient inputs, although monitorization is fundamental for the success of safety resources reuse without compromising the balance of the nutrients and improving the tomato production sustainability.

References

Costa, M., Berkmoes, E., Beerling, E., Nicol, S., Magán, J., Garcia, J., Cáceres, R. (2020). EIP-AGRI Focus Group -Circular horticulture Mini-paper -Water use in greenhouse horticulture: efficiency and circularity

Acknowledgements

TomatInov Project PDR2020-101-032136 is promoted by PDR2020 and co-financed by FEADER under the Portugal 2020 initiative, Action 1. 1. Operational groups.

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Tomate do Oeste

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The Project

To reach the recognition of Oeste region, as a distinctive territory for fresh, and sensorial consistent, quality tomato production, TomatInov Project develops high quality tomato while improves resource use efficiency. To reach more profitable market windows in the european market, environmental conditioning is used to get early productions while maintaining or improving fruit quality, but consumer opinion still persists in the flavorless of out of season tomato. To overcome this perception, TomatInov assesses the quality of fruits produced in environmental conditioning (heating) and without environmental conditioning, through sensory, physical and chemical analysis.

The project involves numerous economic agents related to the horticultural sector in Portugal, which ensures the effective transfer of knowledge necessary for the production of *Tomate do Oeste*.

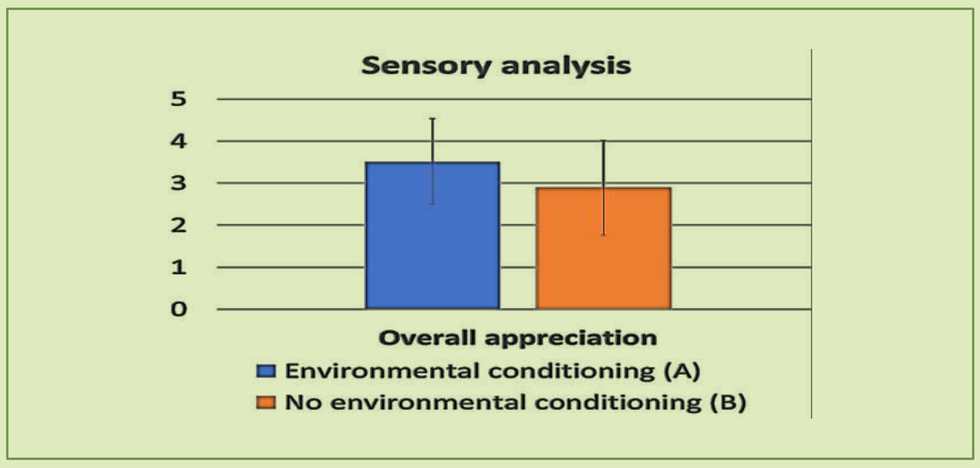

Figure 1. Overall perception in sensory analysis.

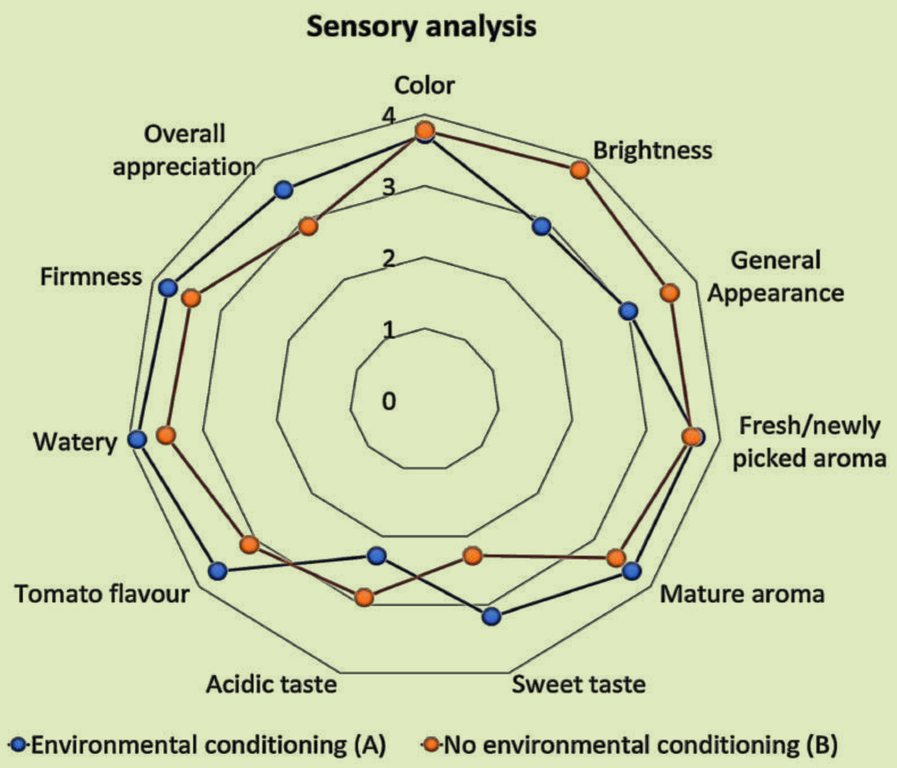

Figure 2. Sensory analysis results.

Results

Table 1. Laboratory results. Values followed by different letters are statistically different ($p<0.05$, ANOVA followed by Tuckey test).

Parameters	Environmental conditioning (A)	No environmental conditioning (B)
Total Soluble Solids (°Brix)	$4.34^{a} \pm 0.27$	$3.64^{b} \pm 0.21$
Total Acidity (g/100g)	$0.57^{b} \pm 0.08$	$0.67^{a} \pm 0.02$
Maturation Index	7.61	5.43

The maturation index can be calculated using the total soluble solids and acidity values, and is a commonly used indicator for the sensory characterization of tomatoes. The fruits from greenhouse A present a higher value of this parameter (Table 1), which indicates a better proportion of acidity and sugar, originating a smooth flavour, associated to a good quality of the fruit, proven by the better global appreciation obtained in the sensorial analysis (Figure 1). The lower values of greenhouse B are indicators of a more acidic flavour (Lucas, 2014), which is verified with the acidity value obtained in the lab (Table 1) and with the perception of acidity in the sensory analysis (Figure 2).

Acknowledgements

TomatInov Project PDR2020-101-032136 is promoted by PDR2020 and co-financed by FEADER under the Portugal 2020 initiative, Action 1. 1. Operational groups.

References

Lucas, H.I.S. (2014). Avaliação química, física e reológica de frutos de genótipos de tomateiro de acessos tradicionais frescos e refrigerados, Dissertação para obtenção do grau de Mestre em Tecnologia Alimentar, ESA, Instituto Politécnico de Santarém.

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MaisSolo

1/07/2017 to 31/12/2021

PDR2020-101-030825

https://maissolo.webnode.pt/

Consortium

COTHN – Centro Operativo e Tecnológico Hortofrutícola Nacional – Centro de Competências
IPSantarém – Instituto Politécnico de Santarém
iniav
Fertiprado
agromais
Fnop – Federação Nacional das Organizações de Produtores de Frutas e Hortícolas
Torriba – Organização de Produtores de Hortofrutícolas S.A.
Sociedade Agrícola S. João de Brito, S.A.
Sociedade Agrícola Herdade das Malhadinhas, Lda

OG (operational group) MaisSolo

Improving the use of resources in agricultural production, with emphasis on biodiversity and soil and water conservation.

Application of alternative technologies to chemical soil treatment, with technical and economic feasibility, easy to integrate into the technical profile of Ribatejo traditional cultural systems.

Support for more informed decision-making.

Tasks

Pilot fields with different technologies;
Samples and observations recording in the cover crops and main culture;
Crop enemy's evaluation;
Positive externalities analysis;
Biodiversity indicators analysis and definition.

Main Results

The introduction of cover crops improved the soil microbiological status, by increasing soil enzyme activities and favouring plant-beneficial microorganisms, including plant growth promoters, symbiotic nitrogen-fixers and endomycorrhizal fungi.

All treatments (biofumigation, mixture and *Lolium* sp.) contributed to the decrease in the number of plant parasitic nematodes and to the increase of beneficial nematodes, improving the soil's biological state.

The differences between the treatments in each experimental field are not relevant in relation to arthropods (organisms that move easily). However, different cropping systems allow identifying clear differences with respect to the abundance and diversity of morphotypes. The indices that characterize these parameters are under development.

Outputs

New product as the best solution for the cover culture;
Easy-to-use tools to support stakeholders.

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Physiological responses of tomato plants to greenhouse environmental conditions

TOMA INOV

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The study

The physiological responses of tomato plants (*Solanum lycopersicum* var. Rosalinda) to incident light conditions in a greenhouse without environmental conditioning were accessed to understand plant development and physiologic responses to the environment. Photosynthetic photon flux density (PPFD) and temperature at the leaf surface were measured, respectively, with a quantum sensor and a thermocouple, both incorporated in the cuvette of a gas exchange system (LCpro-SD), as well as the leaf net CO_2 assimilation (An), stomatal conductance (g_s), sub-stomatal CO_2 concentration (C_i) and the transpiration rate (E). Measurements of chlorophyll fluorescence were performed by using a portable pulse amplitude modulation fluorometer (Os5p). The maximal photochemical efficiency of PSII was estimated by the fluorescence ratio Fv/Fm and was measured in leaflets, which were previously dark-adapted during 30 min. Leaf area was measured with a CI-203 Handheld laser leaf area meter (CID Bioscience). The carbon and water balances were determined considering the extrapolation of the leaf area obtained in table 2 (1 leaf) for 1 hectare, 8 leaves per plant, 20.000 plants/ha and a photoperiod of 14h.

Table 1 - Average values (± SE) of the analyzed parameters.

Hydroponic tomato greenhouse	**[CO_2] Environment**	**PPFD**	**Leaf temperature**	**Sub-stomatal CO_2 (C_i)**	**Transpiration rate (E)**	**Stomatal conductance (g_s)**	**Net CO_2 assimilation (A_n)**	**WUE***	**Fv/Fm**
	vpm ($\mu molCO_2.mol^{-1}$)	$\mu mol.m^{-2}.s^{-1}$	^0C	vpm ($\mu molCO_2.mol^{-1}$)	$mmolH_2O.m^{-2}.s^{-1}$	$molH_2O.m^{-2}.s^{-1}$	$\mu molCO_2.m^{-2}.s^{-1}$	$\mu molCO_2.mmolH_2O^{-1}$	
N=46 10:45 h-11:05 h 163 DAP**	402.1 ± 0.4	604.0 ± 30.8	31.9 ± 0.1	286.2 ± 4.3	2.83 ± 0.06	0.180 ± 0.009	8.2 ± 0.2	2.93	0.800 ± 0.003

*WUE - Water use efficiency; ** DAP – Days after plantation

Table 2 - Leaf area determination.

LEAF AREA (cm^2)	**Plant 1 (3 leaves) TOTAL: 70 leaflets**	**Plant 2 (4 leaves) TOTAL: 98 leaflets**
Sum	159.47	160.53
Average	7.09	6.57
Maximum	14.21	16.50
Minimum	1.67	1.61

Table 3 - Carbon and water balance.

Leaf area (m^2/ha)	**Carbon balance $Kg.CO_2.ha^{-1}.day^{-1}$**	**Water balance $m_3.H_2O.ha^{-1}.day^{-1}$**
2568.48	56.96	3.11

Discussion of the results

Leaf net assimilation (A_n) and transpiration rate (E) alters along the day, depending on PPFD, leaf temperature and [CO_2] environment. The knowledge, monitoring and control of these factors, by the producer, are of the most importance for improve optimum environmental conditions to plant development during the growth cycle.

The results present in table 1 show that the plants of this study are in the optimal values of maximal photochemical efficiency (Fv/Fm). The values obtained in table 2 were used for the determination of the carbon and water balances present in table 3. The balances determined are very important to understand the plants function in the CO_2 equilibrium in the greenhouse and the real water necessities during the productive cycle, considering water use efficiency and water balance values.

References

Saraiva, R. *et al.*, 2020. *A review of greenhouse tomato technologies and their influence in Portuguese production*. Work developed in the context of TomatInov Project: Escola Superior Agrária – Instituto Politécnico de Santarém

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Animal slurry hygienization for use in industrial horticulture Project "CleanSlurry" PTDC/ASP-SOL/28769/2017

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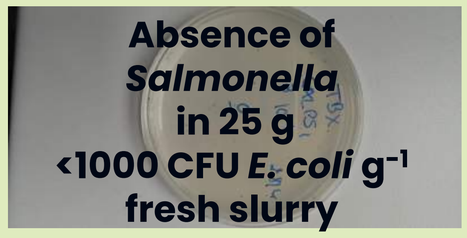
Project "CleanSlurry"

- Aims to develop a new integrated animal slurry (AS) sanitization treatment, through pH adjustment, which:
  - Does not produce new waste
  - Improves AS fertilizer value
  - Contributes to the valorization of AS as an alternative fertilizer/corrective material for horticulture

Animal slurry sanitization by pH adjustment



Organic fertilizers for horticulture

Main Tasks:

1. AS sanitization through alkalinization or acidification - process optimization
2. Control of gaseous emissions during AS alkalinization treatment → biofilters
3. Physicochemical characterization of hygienized slurry, and biofilter subproducts → N, P and C dynamics after soil application
4. Application of biofilter subproducts as organic fertilizers in horticulture
5. Evaluation of the impact on soil fertility of the AS hygienization treatments, after application
6. Evaluation of the economic viability of the process

Fig 1. Higienized and raw pig slurry for field application

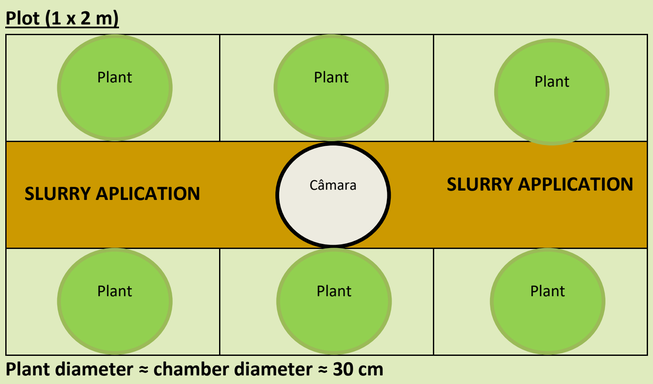


Fig 2. Slurry application scheme.

Fig 3. Field experiment at Tapada da Ajuda, Lisboa.

Work in progress – Field experiment

- To study the impact of slurry higienization treatments on the fertilizer value of AS, crop productivity and greenhouse gases (GHG) emissions (N_2O, CH_4 and CO_2).
  - @Tapada da Ajuda, Lisboa
  - 18 plots (1 m x 2 m)
  - 108 cabbages
  - 6 different fertilization treatments (3 rep.):

A. Raw pig slurry (PS)
B. Acidified PS with H_2SO_4 [pH=5.0]
C. Alkalinized PS with KOH [pH=9.5]
D. Alkalinized/neutralized PS [pH=7.0]
E. Mineral fertilizer
F. Control, without fertilizer application

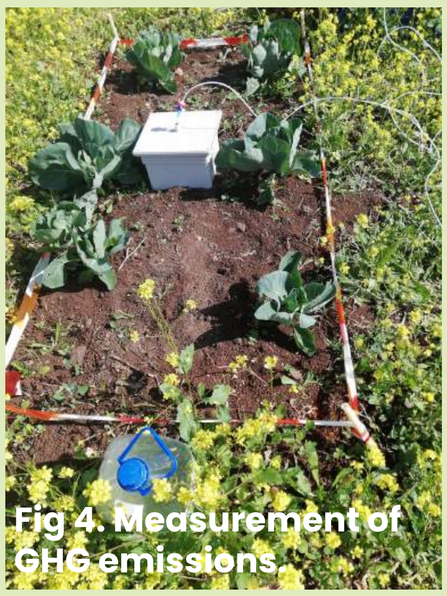


Fig 4. Measurement of GHG emissions.

-Physico-chemical analysis of soil samples
-Measurement of GHGs emissions
-Microbiological analysis of plant material to detect pathogen contamination
-Evaluation of produtivity/quality of the produce

Acknowlegements: This research was funded by the Project CleanSlurry PTDC/ASP-SOL/28769/2017, "Animal slurry hygienization for use in industrial horticulture", and by the logistic and institutional support of LEAF (Linking Landscape, Environment, Agriculture and Food Research Unit), funded by FCT (UID/AGR/04129/2020).

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Recovered Organic Materials and Composts for Precision Fertilization of Permanent Crops

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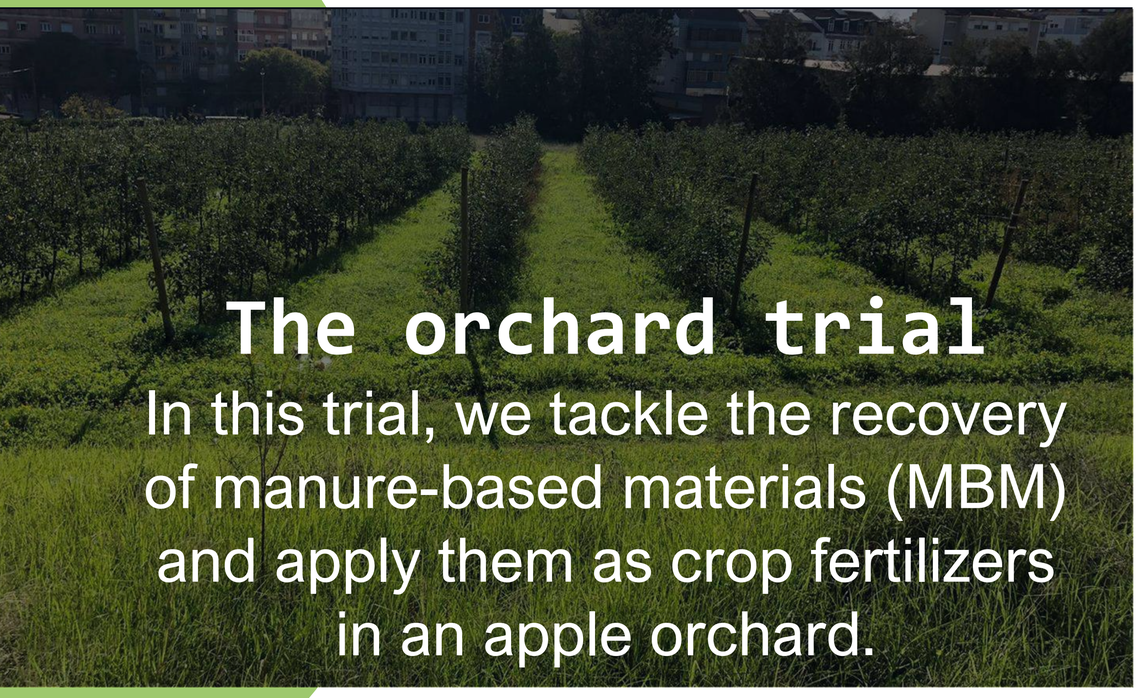
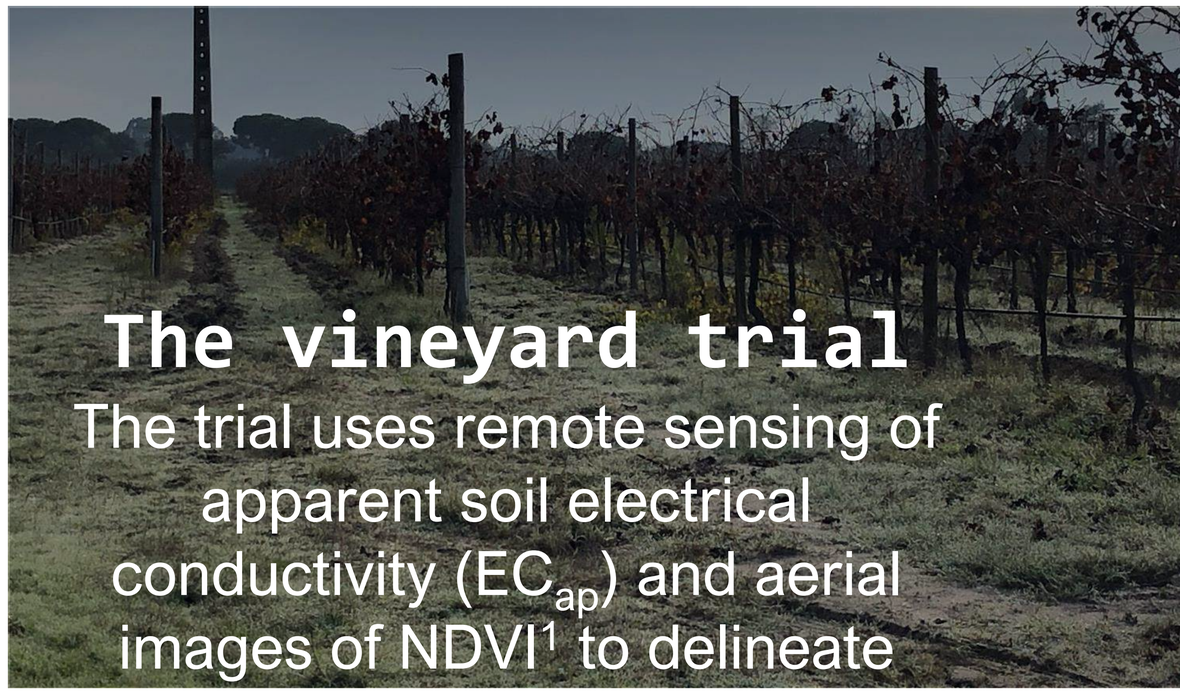
Introduction and aims

The present work has two parts, one in a vineyard and one in an orchard, and is framed within the Nutri2Cyle project, which aims at the transition towards a more carbon and nutrient efficient agriculture in Europe.



The orchard trial

In this trial, we tackle the recovery of manure-based materials (MBM) and apply them as crop fertilizers in an apple orchard.



The vineyard trial

The trial uses remote sensing of apparent soil electrical conductivity (EC_{ap}) and aerial images of NDVI[1] to delineate zones within the vineyard to assess the potential for precise fertilization (PF) implementation.

Some results

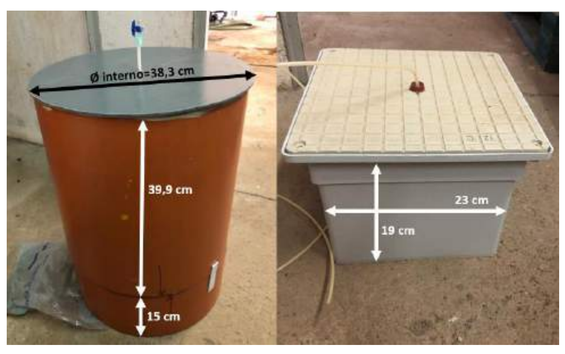
The MBM had the same fruit production of its mineral counterpart, as well as fruit quality. However, the MBM did improve leaves' nutritional status.

Overall results

EC_{ap} and NDVI combined were efficient in the delimitation of three distinct zones, with homogeneous chemical and physical characteristics within, indicating a potential for PF implementation. However, not in the case of phosphorus fertilization, as soil P content did not significantly change with zones.

Future work

Another purpose of the trial is the evaluation of greenhouse gases production consequent from MBM application, which is still an on-going work.



*Gas chambers

[1] Normative difference veggetation index

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773682.

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Qualitomate

1/09/2017 to 31/12/2021

PDR2020-101-032076

GOALS

- Guarantee the quality of the final product in processing tomato
- Development of a new fresh tomato product with high quality by color level
- Identify the species that causes damages, the practices responsible for increasing populations, especially in the final phase of the season.

Pests as whiteflies, eriophyid mites and tomato South American moth can compromise the RED color in the fruit's pulp that is a conditioning characteristic in the processed tomato industry

Tasks IPM

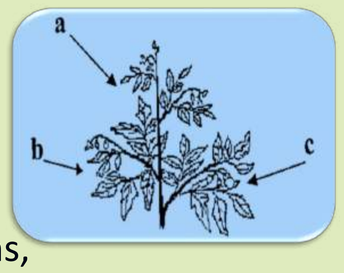
- Identification of the main species / biotypes of the pests
- Protection strategies for risk assessment, decision making and selection of protection practices
- Mapping of locations with lack of color problem

Main Results

The strategies to be implemented in each year, location and plot require a careful assessment, for each situation, by the decision maker, based on ecological and technical specificities, which will condition the evolution of pest populations and the success of the implemented strategy of protection.

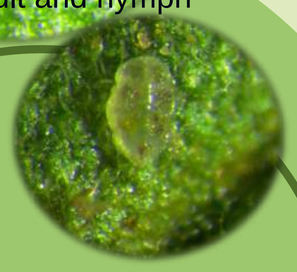
The risk assessment **weekly**

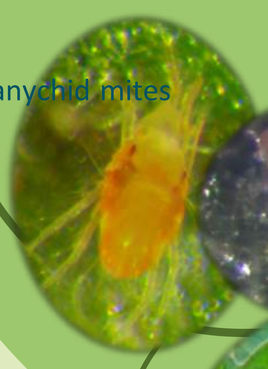
- Quantification of: on **traps** / on **plants**
  - whitefly adults on traps
  - South American tomato moth on traps
- Visual observations on plants:
  - Whiteflies: 25 leaflets in the position a; 5 in position b and c



  - Mites: With favorable conditions, observe movable forms in three leaves/plant position
  - South American tomato moth: 1 leaf/plant position, 2 green fruits, 1 ripe fruit/plant)\

Whitefly adult and nymph





anychid mites

Eriophyid mites

South Amrican tomato moth adult

South Amrican tomato moth larva

Outputs

Solutions and techniques for easy application and intelligent strategies with risk assessment techniques and expeditious decision tools

Easy-to-use tools to support stakeholders.

https://Qualitomate.pt

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FruitFlyProtec

Main results 2018-2021

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To improve protection of berry crops for *Drospohila suzukii*

Goal

- Risk assessment
- Evaluation of environmental friendly crop protection methods

Methods

- Traps and attractants

Lasa trap: 50 ml vinegar of Mendes e Gonçalves and yeast (Lasa et al., 2017)

PET with red and black bands and vinegar of Mendes e Gonçalves (200 ml)

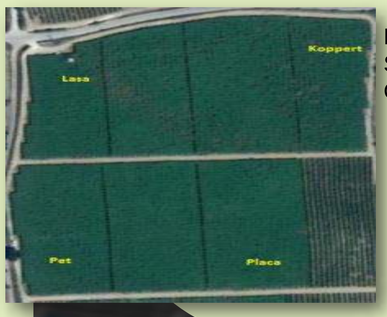
Koppert trap with Koppert attractant (200 ml)

Adhesive trap Econex+ Econex attractant (first 6 months)

Biobest trap with Biobest attractant (200 ml)

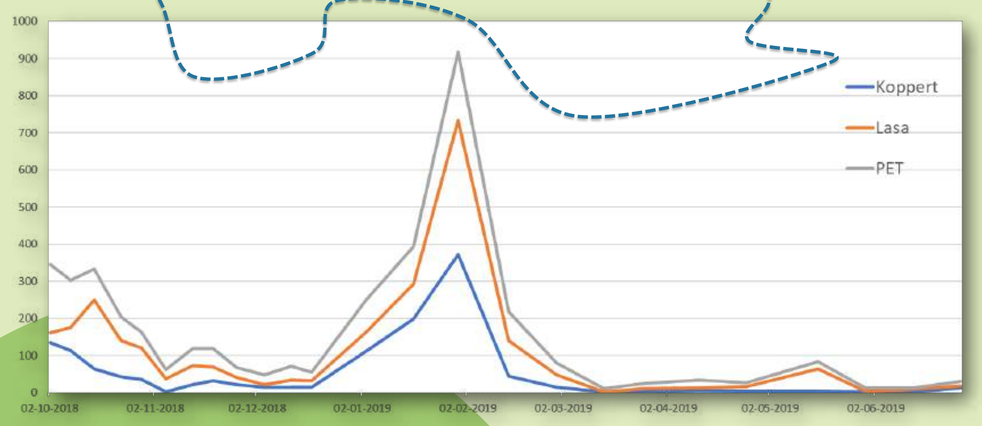
- Observation periodicity: weekly in Summer; fortnightly in Winter
- The insects were preserved in the lab in ethanol 70% until identification
- Identification using morphological characteristics under a stereoscopic microscope
- Evaluation of entomopathogenic nematodes (EPN) efficacy on larvae and pupae in Petri dish and in pot (soil) – *Steirnernema carpocapsae*, *S. feltiae* and *Heterorhabditis bacteriophora*, 50 IJ/cm^2 and 100 IJ/ cm^2 (20 insects/replication/treatment, 3 replications)

- Two Biological Observation Stations (POB):

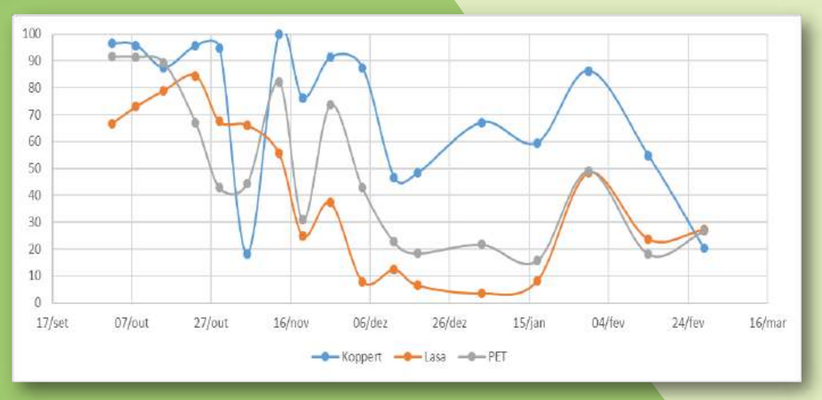


POB Santarém (Vale de Figueira, Santarém) in a table grap vineyard cv Cardinal

POB Sudoeste Alentejano (Zambujeira do Mar, Odemira) in greenhouse raspberry



Total number of adults of *D. suzukii* catched in the traps (POB: Sudoeste Alentejano).



Proportion of *D. suzukii* / other *Drosophila* species - specificity of the traps (POB: Sudoeste Alentejano).

Results

- Econex adhesive traps did not catch any *D. suzukii* flies but only Psychodidae mosquitos
- Biobest attractive became browny and a gelatin consistency which difficult identifying and counting the flies (and probably decrease the captures)
- Lasa trap is more difficult to manipulate

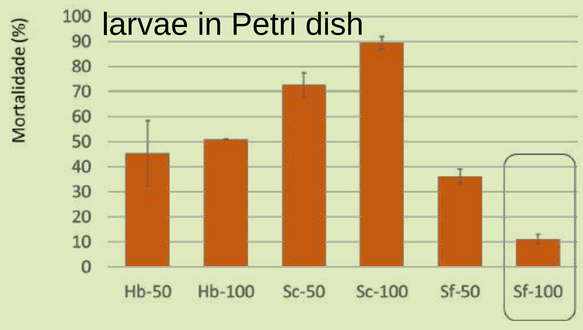
- **In the Ribatejo POB** in vineyards we did not capture *D. suzukii*

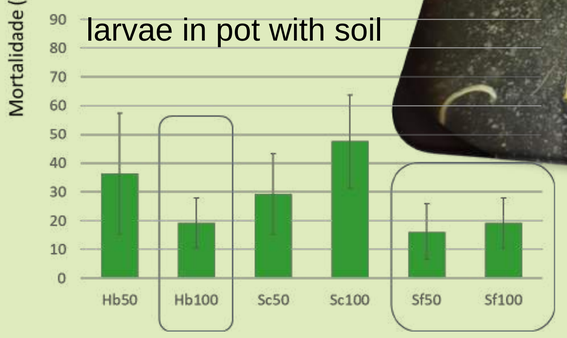
- **In the Sudoeste POB** in raspberries:

  - PET was significantly more efficient in catching *D. suzukii* adults than Koppert trap (Lasa presented middle catch values) (Friedman: $\chi 2=11{,}521$; g.l.=2; p=0,003; PET *vs* Koppert p=0,003)

  - Koppert trap was more specific (regarding proportion with other *Drosophila* species): in average 72% of *Drosophila* spp. was *D. suzukii* (Lasa: 41%; PET 49%).

- **EPN – lab assay**
  - On larvae *S. carpocapsae* was more efficient both in Petri dish and pot
  - There was no mortality on pupae





GO consortium

COTHN – Centro Operativo e Tecnológico Hortofrutícola Nacional – Centro de Competências
Instituto Superior de Agronomia – Universidade de Lisboa
LEAF – Linking Landscape Environment Agriculture and Food – Research Center
Escola Superior Agrária [IPSantarém]
[IPSantarém] Instituto Politécnico de Santarém

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HORTICOVER

Improvement of agricultural monoculture systems using cover crops

2020-2023

The major target is the development of a new product as an intercropping solution to autum–winter crop season, based on a mix of selected seeds with legumes and grasses tailored to specific ecological conditions

- **Short cycle species and solutions performed to diferente ecological conditions**
- **Species to face climate changes scenario**

Tasks

1	Selection of plant ecotypes with short cycle and good performance to climate change: lack of water and high temperatures
2	High production and mix better combination to the diferente crop systems
3	Test and agronomic evaluation of the mix solutions as cover crops at Ribatejo and Alentejo agro-industrial crops in combination with minimal soil mobilization
4	Positive externalities evaluation and definition of good sustainability indicators: soil biodiversity, soil structure and carbon balance
5	Results: demonstration and comunication

First Results

First year

1	Ecotypes selected to find new varieties adapted for cover crops mixtures

Outputs

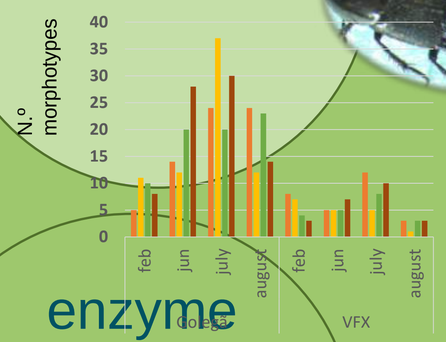
biodiverse mixtures with legumes and grasses

- Natural resources management
- Carbon balance
- Soil biodiversity

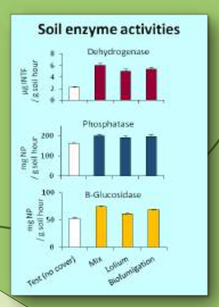
Indicators to evaluate soil health

arthropods and anelids

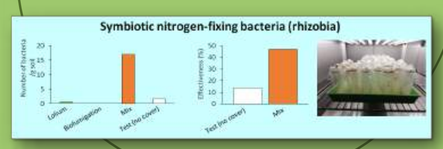
Staphilinidae



enzyme activities



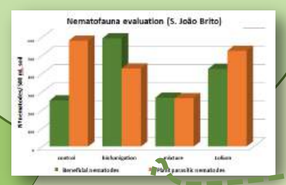
beneficial microorganisms



Mycorrhizae

nematodes

Predator-Mononchida



carbon capture

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Nitrogen in irrigation water sources, the missing link between farmers practices and agri-environmental indicators

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Background and objectives

The nitrogen (N) in the irrigation water sources is a missing link since it is often not included in the agri-environmental indicators that are used to assist in agricultural policies. To gain insight on how relevant this input is in the agricultural N cycle we calculated for the 278 municipalities in mainland Portugal (1995-2017):

- Gross irrigation requirements at the municipality level using the GlobWat model
- Spatially explicit nitrate concentration in surface- and groundwater (500x500m)
- The relative importance of two irrigation water sources
- The impact of including this nitrogen input in two agri-environmental indicators

Results & Discussion

The N in irrigation water sources ranged from 11-16 Gg N/yr in mainland Portugal for the period 1995-2017. Approx. 71% of this N input was from groundwater. The magnitude of the N in irrigation water sources depended on the overlap between high irrigation demand and high nitrate concentration in groundwater. This is particularly relevant for Southern Portugal where this input reached up to 107 kg N/ha/yr.

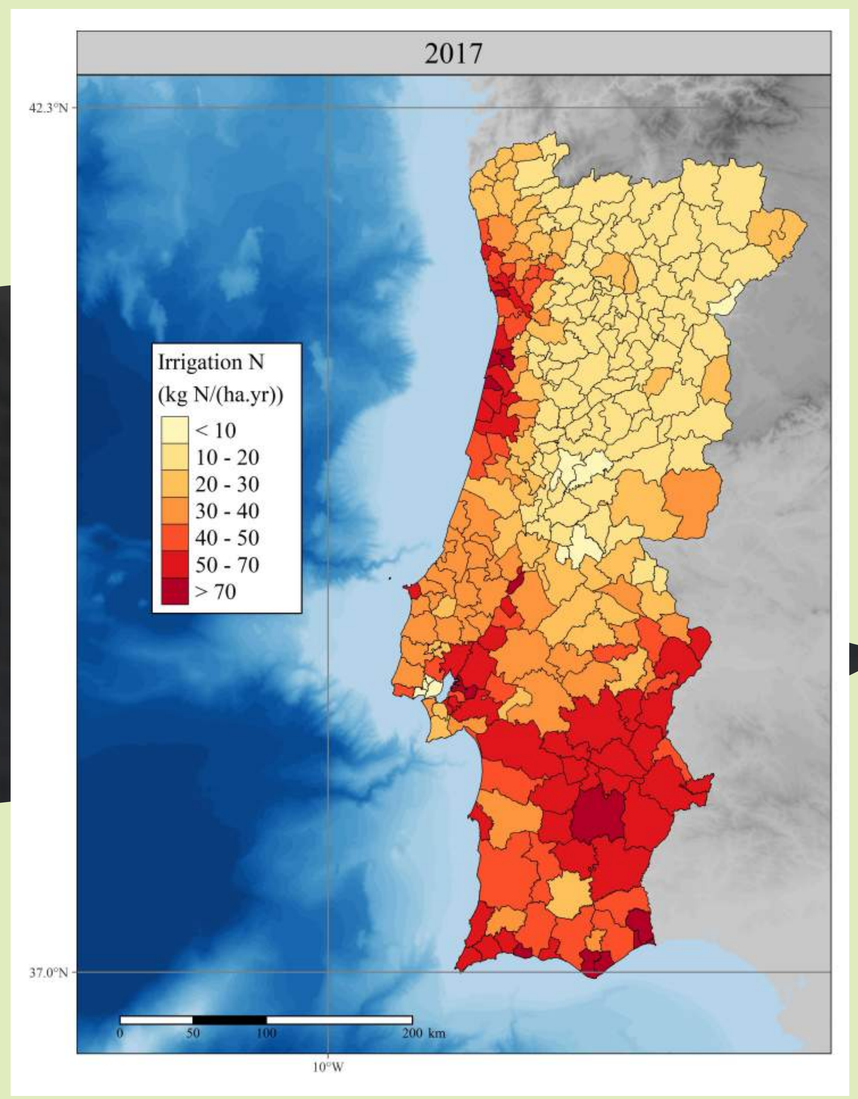

Fig 1. The N in irrigation water sources for 2017.

The local relative importance of N in irrigation water sources was considerable, up to 45% of the sum of all N inputs (manure, N fixation, deposition, inorg fertiliser). By including this missing input in the nitrogen use efficiency (NUE), the NUE declined sometimes up to 78%.

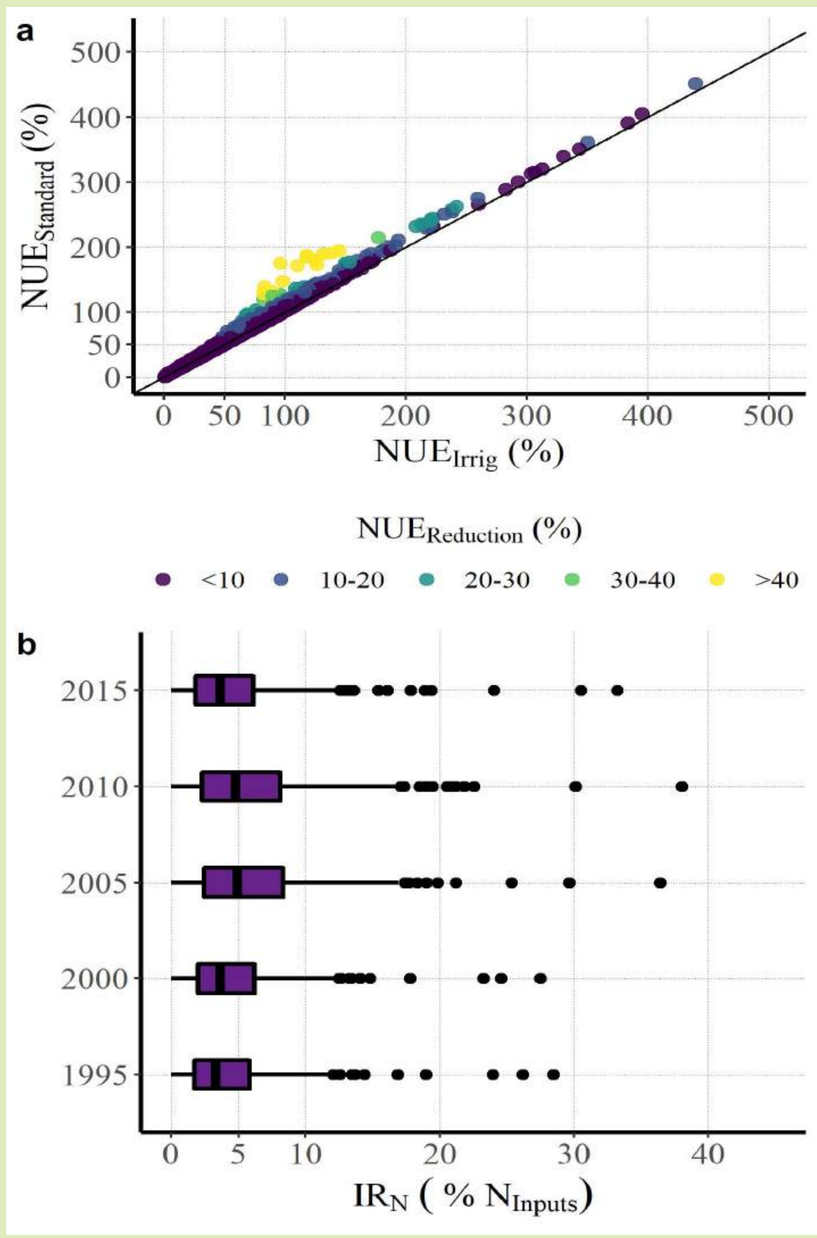

Fig 2. a) Impact on the nitrogen use efficiency with(NUEirrig) and without (NUEstandard) irrigation. b) Fraction of the N in irrigation water relative to the N inputs in five snapshot years.

Lessons to take

- The N in irrigation water can be a substantial N input in regions with high irrigation with nitrate-contaminated groundwater sources;
- Irrigation has the potential to offset the demand for inorganic fertilisers to some extent
- The current indicators are likely underestimating the real magnitude of N pollution while overestimating the nitrogen use efficiency of agricultural systems where irrigation is common;

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Evaluation of the acceptance of a gluten-free beer

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Introduction, objectives and methodology

Celiac disease affects about 1% of the world population. The sensitivity to gluten is even greater. Beer is made from malted barley grain, which contains gluten. Thus, the market trying to adapt to this market share has developed a gluten-free beer.

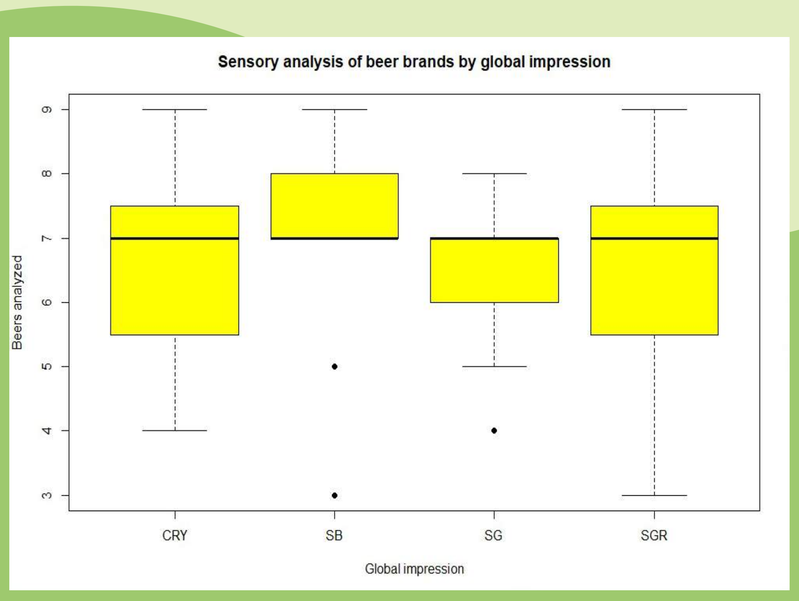
The objective of this work was to evaluate the acceptance of a commercial gluten-free beer and to compare the results with other commercial beers available on the market.

A sensory analysis, with a stratified hedonic scale of 9 points, was carried out with 20 tasters to classify the global impression of each beer.

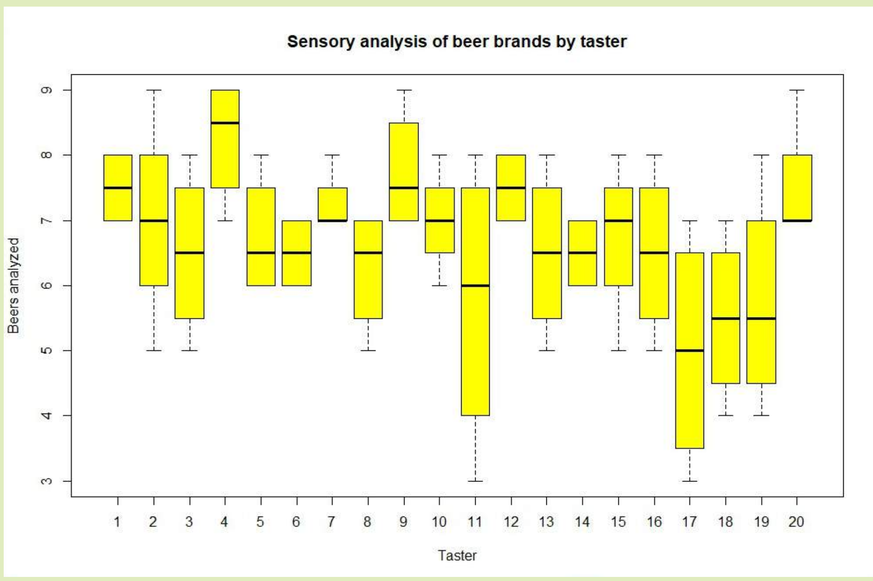
A two-way analysis of variance (ANOVA) was performed as a statistical treatment to assess the factors: "beer brand" and "taster", using the RStudio software.

Results and conclusions

The graph (A) shows the result when the "Beer" factor is analyzed, which is quite homogeneous in the general context. For this factor, the result of the P-value calculated in ANOVA was 0.3941, which shows that the null hypothesis cannot be rejected.



As for the "Taster" factor, the graph (B) shows a discrepancy between the samples. The P-value obtained in ANOVA was 0.04, which means that the alternative hypothesis must be considered, that is, the beers analyzed are different from the sensory perception of the tasters.



It appears from the data presented that, according to the sample used, gluten-free beers have a similar global impression analysis, although the tasters' perception is quite different.

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LOW COST SOLUTIONS FOR HIGH COST PROBLEMS @INDUSTRY

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Overview

Today, wineries have several wastewater treatment problems, mainly due to the seasonal nature of their work. This work aims to contribute to the resolution of this problem through an essentially practical approach, focused on obtaining a quality treated effluent that can be reused. For this it will rely on the rehabilitation of existing treatment systems through the development of a monitor and control system. This system, with continuous water quality monitoring, will allow the improvement of the treatment efficiency with lower treatment costs, while reducing environmental impacts.

System Development

The system under development will focus on IoT solutions, bringing Industry 4.0 all the way to the wastewater treatment plants. This system will have the capacity to monitor and adjust the treatment intensity in order to guarantee the quality of the treated effluent, adapting the treatment to the retention time verified and being able to emit alerts in case of any failure/anomaly in the system.

SUSTAINABLE DEVELOPMENT GOALS

6 CLEAN WATER AND SANITATION
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
13 CLIMATE ACTION

Objectives

- Low cost and user-friendly solution
- Increase treatment system efficiency
- Prevent environmental impacts
- Reduce operational costs
- Monitor wastewater quality

Acknowledgements

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BIOMA
Soluções integradas de BIOeconomia para a Mobilização da cadeia Agroalimentar

Soluções de valorização de resíduos e subprodutos agroalimentares

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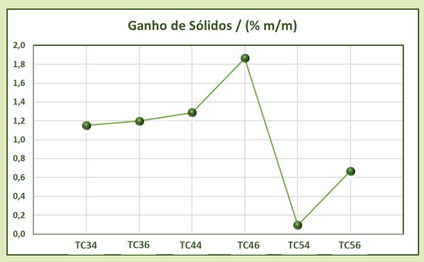
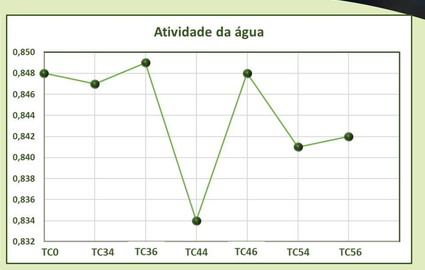
O projeto mobilizador de I&DT "BIOma – Soluções integradas de BIOeconomia para a Mobilização da cadeia Agroalimentar" reúne um consórcio alargado de 24 entidades nacionais inseridas na fileira agroalimentar, tais como hortofrutícolas, vitivinícola e azeite, entre outros, com o desígnio de reposicionar as empresas da cadeia de valor agroalimentar (CVAA) em patamares mais competitivos e sustentáveis, promovendo estratégias e um ecossistema que potenciem de uma forma inovadora a adoção de soluções integradas de Bioeconomia. O Instituto Politécnico de Santarém é responsável pelo suporte técnico à Atividade 1 da PPS3 do projeto, cujo objetivo é desenvolver novos produtos alimentares a partir de subprodutos hortofrutícolas. Para o efeito serão consideradas as seguintes etapas:
1) Seleção da solução osmótica (SO): i) ensaios preliminares utilizando diferentes agentes osmóticos (SO), seguida de secagem; ii) Provas organolépticas para avaliar a aceitação de novos produtos.
2) Ensaios preparatórios para definir a proporção de subproduto e SO a usar no pré-tratamento por desidratação osmótica (DO), e avaliação da influência da proporção (R) sobre os diferentes parâmetros do processo.

- Batata
- Couve Galega
- Couve Lombarda
- Pimento Vermelho
- Couve Roxa

Apresentam-se os resultados preliminares para:
1) Talo de Couve Galega

Amostras	Solução NaCl (%)	Tempo (min)	aW	Teor de humidade (% m/m)	%Perda de Peso (PP) (% m/m)	%Perda de Água (PA) (% m/m)
TC0			0,848	91,447		
TC34	3	240	0,847	91,333	14,600	13,449
TC36		360	0,849	91,391	14,571	13,373
TC44	4	240	0,834	92,000	9,182	7,894
TC46		360	0,848	92,667	8,800	6,935
TC54	5	240	0,841	89,404	20,160	20,067
TC56		360	0,842	90,000	21,158	20,489





2) Batata

Amostras	Solução NaCl (%)	Tempo (min)	aW	Teor de humidade (% m/m)	%Perda de Peso (PP) (% m/m)	%Perda de Água (PA) (% m/m)
B0			0,853	91,333		
B34	3	240	0,845	76,316	27,291	35,845
B36		360	0,839	75,000	25,545	35,492
B44	4	240	0,840	77,483	24,649	32,949
B46		360	0,831	74,667	7,750	22,453
B54	5	240	0,844	74,172	28,657	38,417
B56		360	0,838	74,497	25,703	35,984

Parâmetros do processo:
1) Atividade da água (a_W);
2) Teores de humidade inicial e final (%) (Hi e Hf);
3) Perda de peso (%) (PP);
4) Perda de água (%) (PA);
5) Ganho de sólidos (GS).

Considerações preliminares

Tanto para 1) como para 2), verifica-se que ao aplicar a DO com uma concentração de 4%, ocorre um maior ganho de sólidos e uma redução de a_W. Isso pode indicar que poderá ser a concentração mais adequada. Tendo em conta os resultados preliminares, pode-se considerar que o tempo de imersão mais efetivo para o talo de couve é de 240 min (4 h), e para a batata, 360 min ou 6 horas.
Por uma questão de obtenção das melhores condições DO, iremos proceder à repetição destes ensaios para confirmar essas condições tecnológicas para depois se prosseguir no processo tecnológico.

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BIOValue – Soluções de valorização de resíduos e subprodutos hortofrutícolas


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O presente ensaio tem como principal objetivo a produção de compostos de alta qualidade obtidos a partir de resíduos e subprodutos agroalimentares. Serão utilizados para a produção de composto, subprodutos e resíduos hortofrutícolas, bem como palha e estilha, com a função estruturante (Figura 1).

Figura 1 – Estruturantes (Estilha, Palha)

Os ensaios são caracterizados por duas relações C/N (Tabela 1) e dois tipos de estruturantes de forma a determinar o comportamento de cada relação.

Tabela 1 – Metodologias de estudo

C/N = 30	**Palha**
C/N = 30	**Estilha**
C/N = 50	**Estilha**

Para cada tratamento serão realizadas 3 repetições, obtendo cada pilha cerca de 3m^3 de composto num formato de prisma triangular (Figura 2).
As pilhas estão localizadas numa área de 200 m^2 (14m x 14m), previamente construída de modo a facilitar o revolvimento das pilhas e o encaminhamento das escorrências. O arejamento é efetuado através do revolvimento das pilhas.

Tabela 2 – Periodicidade do revolvimento

Nº Dia	Revolvimento a cada
Dia 1 a dia 15	5 dias
Dia 16 a dia 30	7 dias
Restantes dias	15 dias

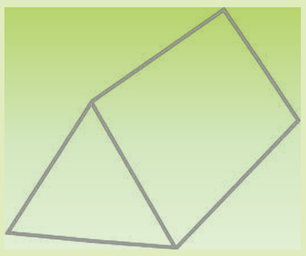

Figura 2 – Formato das pilhas

Para comprovar a estabilização do ensaio, é recolhida uma amostra para um vaso de Dewar com termómetro (Figura 3), realizando 2 leituras diárias durante o tempo necessário.

Figura 3 – Vaso de Dewar

A caracterização dos resíduos e dos materiais estruturantes foi realizada de acordo com métodos standard (Tabela 3).

Tabela 3 – Caracterização do materiais de estudo

Resíduo	Humidade %	Relação C/N
Batata	81,2	34,7
Cebola, casca	77,1	62,7
Alface	96,9	14,6
Couve portuguesa	91,4	11,8
Palha	10,0	96,1
Estilha	15,0	100,4

Os resultados das diferentes modalidades, após três meses de ensaio, serão utilizadas para a otimização/validação do processo de compostagem.

Agradecimentos:
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