



Towards a Safer, Sustainable and Greener Rice Processing: Cutting-Edge Strategies

TRACING RICE AND VALORIZING SIDE STREAMS ALONG
MEDITERRANEAN BLOCKCHAIN

28.10.2024



TRACE-RICE with Grant n° 1934 (call 2019, section 1 Agrofood) is part of the PRIMA Programme supported under Horizon 2020, the European Union's Framework Programme for Research and Innovation

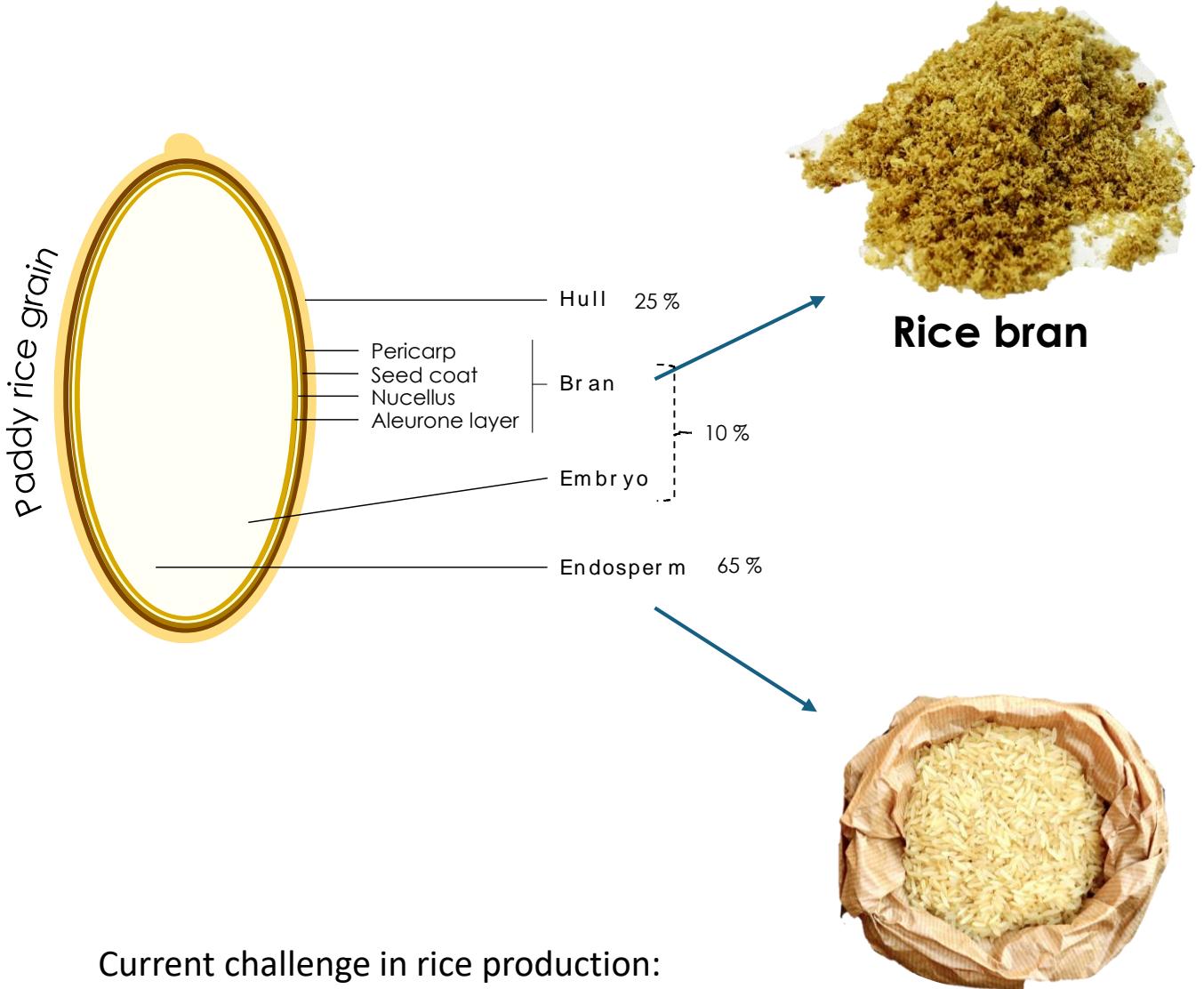


Instituto Nacional de
Investigação Agrária e
Veterinária, I.P.

Introduction

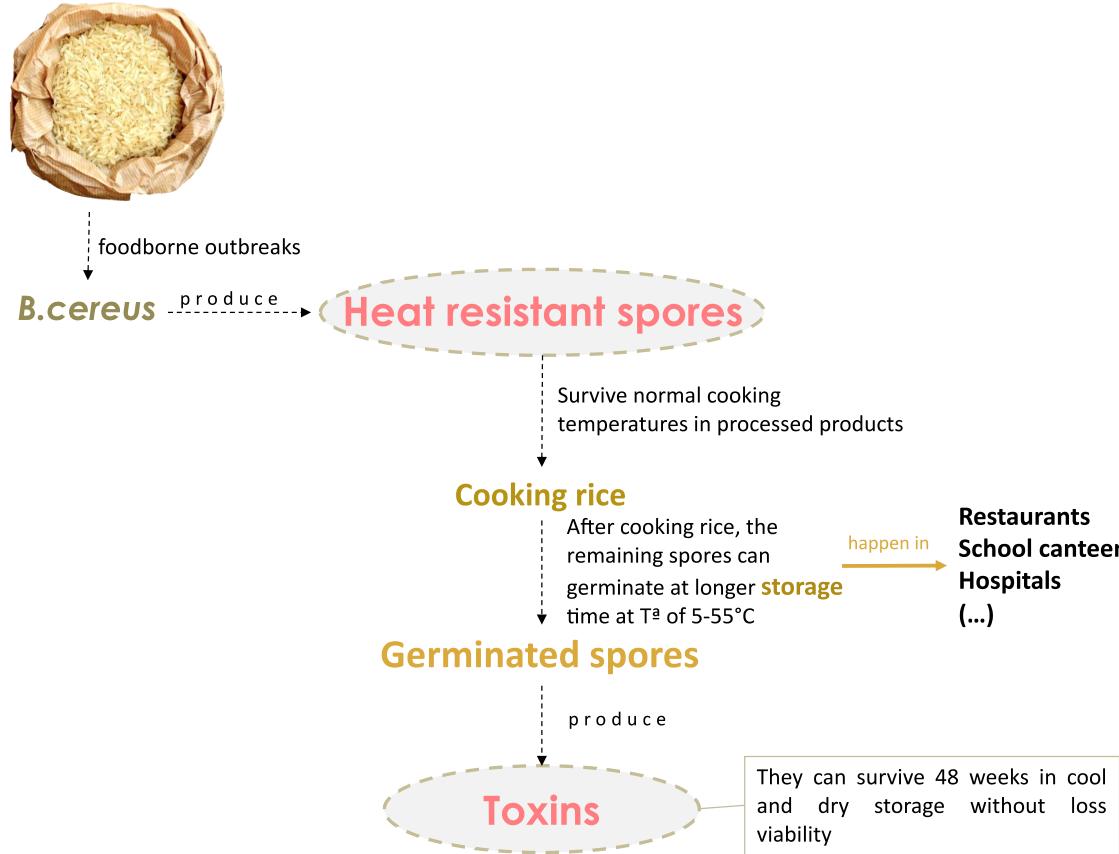


Importance of rice based products in the market



Current challenge in rice production:
Sustainability (rice bran) and **safety** (*Bacillus cereus* spores in cooked rice)

What's the food safety problem?



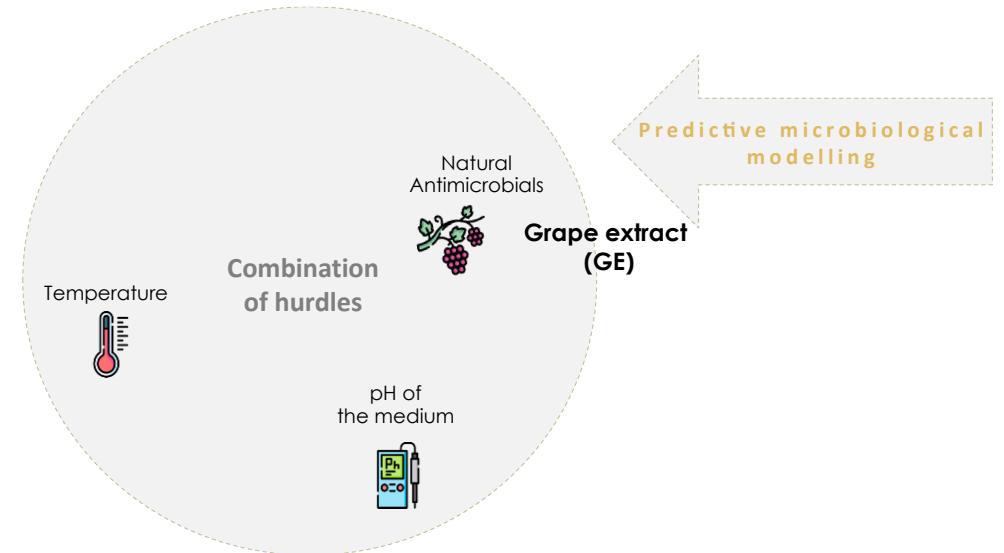
Grape extract at 0.1% inhibits *B. cereus* growth at low pH (4.5) or temperature (10°C), while concentrations of 0.5 and 1% demonstrates bactericidal activity independently of both environmental factors. This method provides strong evidence supporting grape extract as an effective preservation strategy for rice.

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What's the solution?

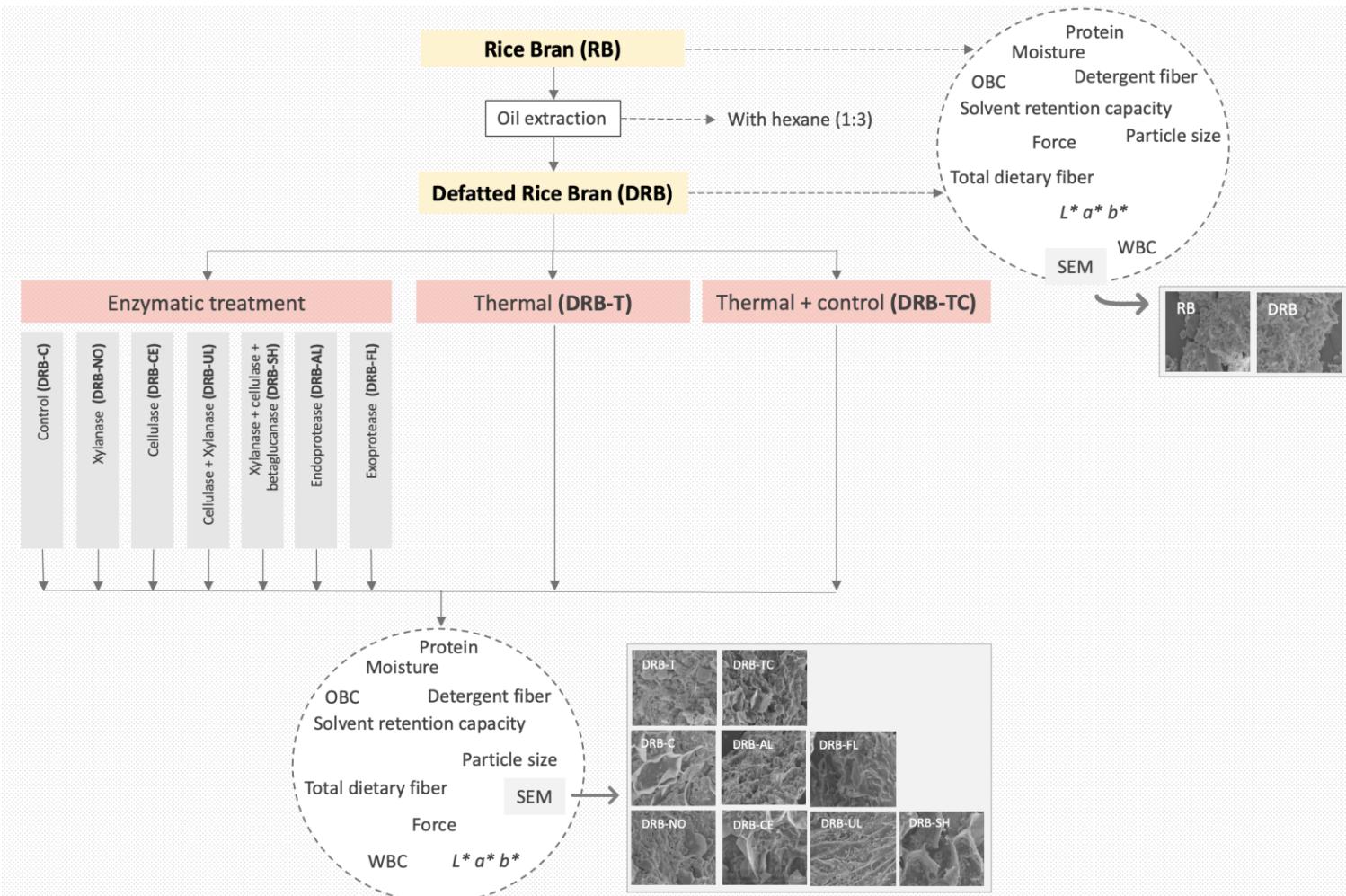


T°	pH	CA	0,1% GE	0,5% GE	1% GE
30°C	4,5	→	→	→	→
	5,5	→	→	→	→
	6,5	→	→	→	→
20°C	4,5	→	→	→	→
	5,5	→	→	→	→
	6,5	→	→	→	→
10°C	4,5	→	→	→	→
	5,5	→	→	→	→
	6,5	→	→	→	→

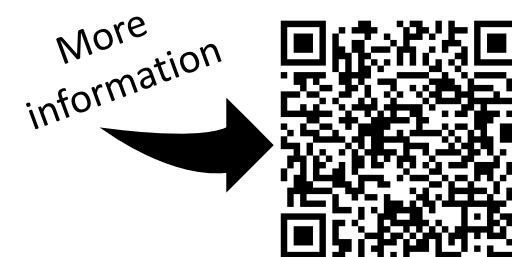


Rice bran: Enzymatic approach to add value

Rice bran



- Enzymatic treatments of bran increase soluble dietary fiber content and reduce particle size up to 50%.
- It enhances hydration properties and solvent retention capacity.

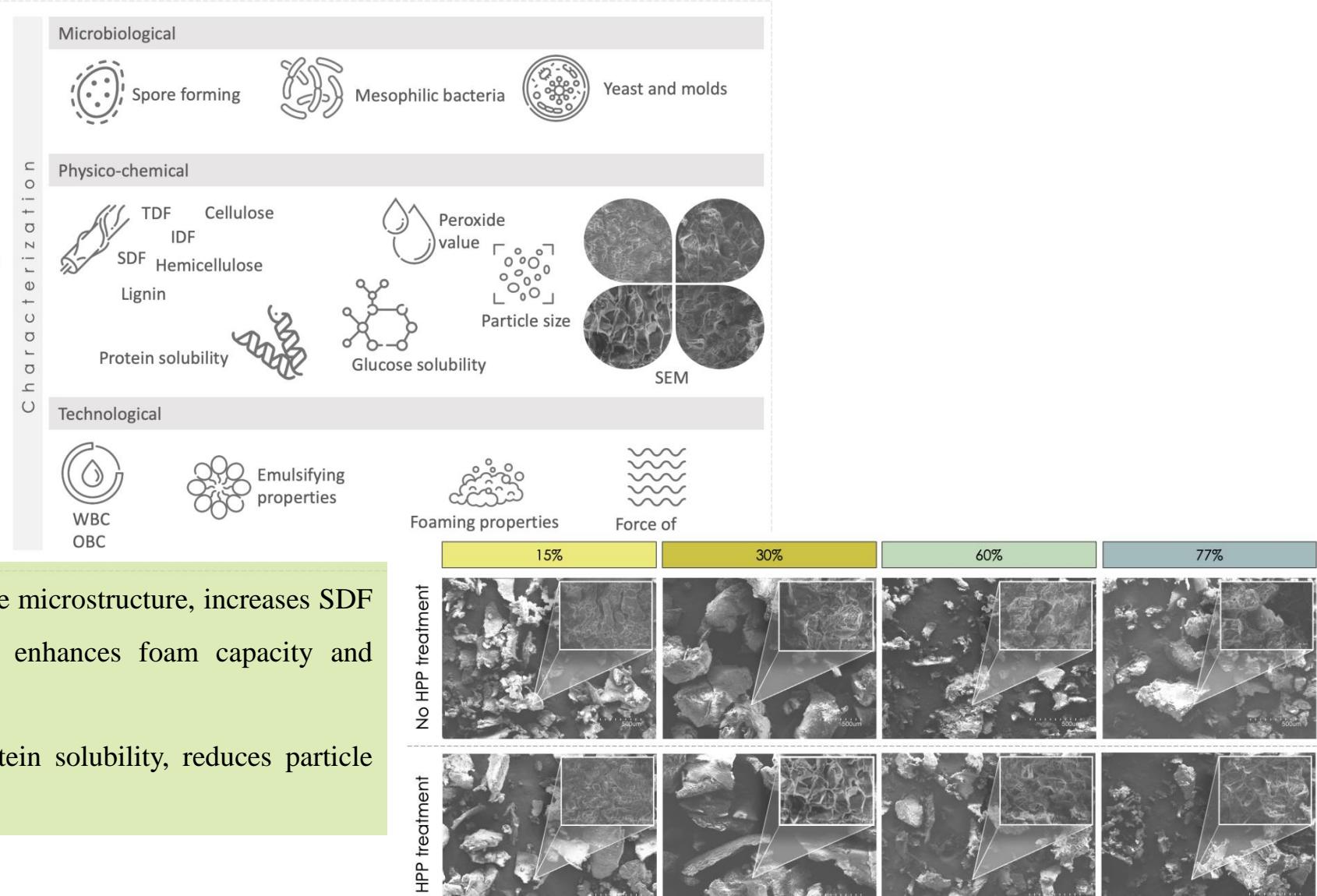
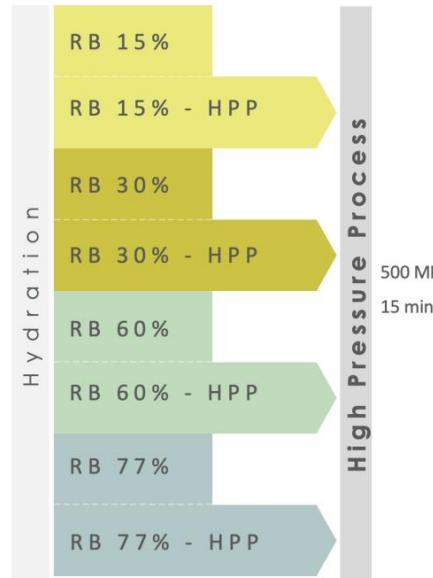




Rice bran: High pressure process (HPP) approach to add value and increase microbial safety

Rice bran

Rice Bran



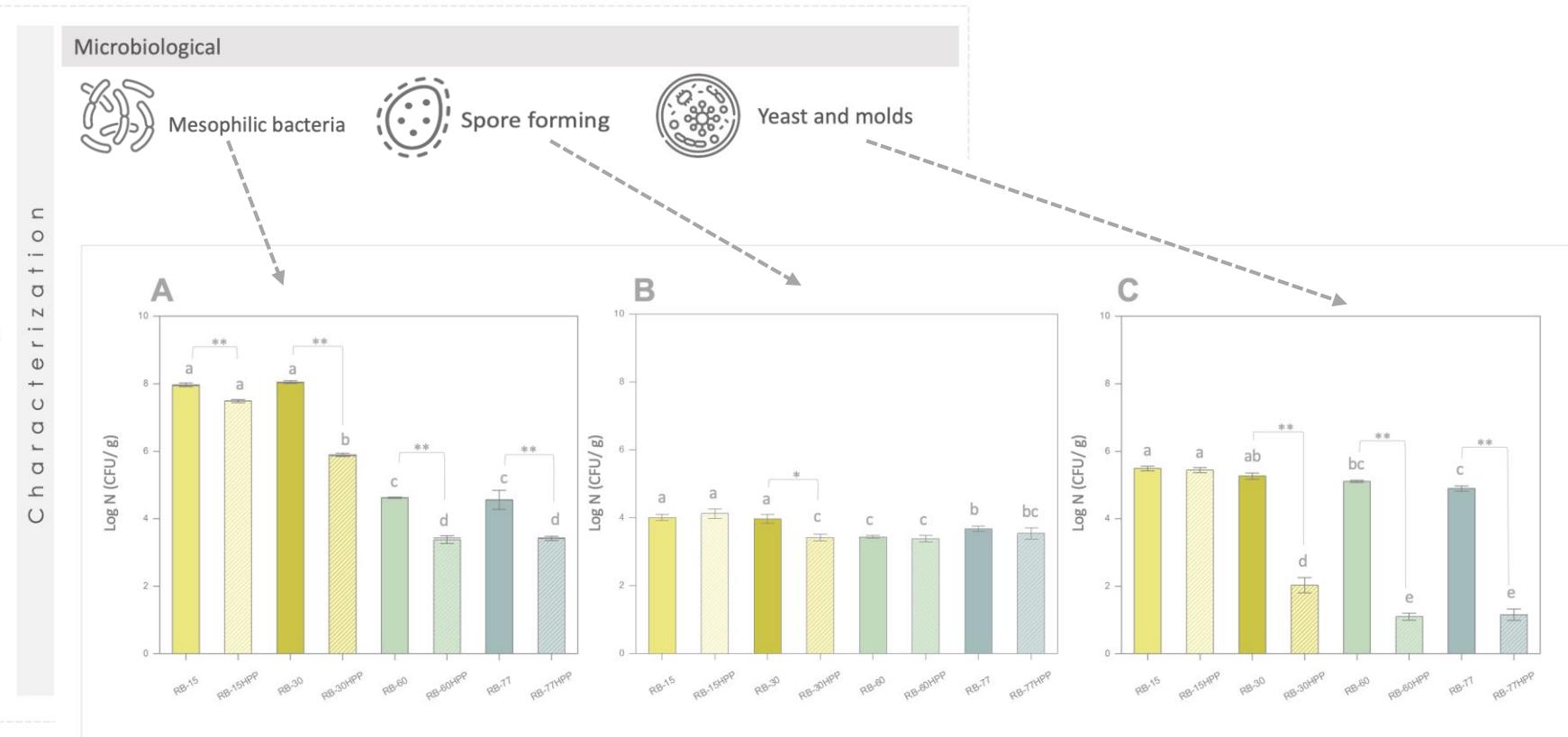
- At low hydration levels HPP can change microstructure, increases SDF content, reduces peroxide value, and enhances foam capacity and stability.
- Higher moisture content increases protein solubility, reduces particle size, and improves WBC and OBC.



Rice bran: High pressure process (HPP) approach to add value and increase microbial safety

Rice bran

Rice Bran
RB



- The higher the hydration, the greater the antimicrobial effect of the HPP treatment for molds and yeasts and mesophilic bacteria.
- Spore forming bacteria are not affected by HPP treatment at any hydration level.

Science communications

1. 10th Food science, Biotechnology & Safety Congress, Latin Food 2022

Benchmarking of rice-based beverages

Eva Grau-Fuentes, R. Garzón, C.M. Rosell

International Trainee Symposium in Agro-food, Nutrition and Health CCARM'2

EVALUATION OF BACILLUS CERESUS BEHAVIOUR IN A RICE MATRIX IN THE PRESENCE OF GRAPE EXTRACT

2. 31st and 1st (2023) and 2nd (2024) International trainee symposium in agro food, nutrition and health CCARM'2

Rapid Fire Research Symposium

Exploring plant-based beverages market: unravelling ingredient functions and nutritional profiles

International Trainee Symposium in Agro-food, Nutrition and Health January 21-24, 2024

New advances from PRIMA projects for improving Mediterranean Agro-Food value chains

19th European Young Cereal Scientists and Technologists Workshop 2022

TRACE-RICE - PRIMA Projects, Instituto de Agroquímica y Tecnología de Alimentos, CSIC

LINCE Research

INTERNATIONAL TRADE: PERSPECTIVE IN AGRO-FOOD, NUTRITION AND HEALTH CCARM'2

Winnipeg, Canada January 19-20, 2023

Evaluation of Bacillus cereus behaviour in a rice matrix in the presence of grape extract

E. Grau, R. Garzón, C.M. Rosell, D. Rodrigo

International Trainee Symposium in Agro-food, Nutrition and Health January 21-24, 2024

Exploring plant-based beverages market: unravelling ingredient functions and nutritional profiles

International Trainee Symposium in Agro-food, Nutrition and Health January 21-24, 2024

Strategies to increase sustainability of rice processing: technological, microbial and nutritional approach

PhD Thesis I 2024

Presented by: Eva Grau Fuentes
Supervised by: M. Dolores Rodrigo Alcoba, Raquel Garzón Uria

Original Research Article

Joint effect of heat, pH and grape extract on *Bacillus cereus* spores survival in a rice solution

Maria Inés Valdez-Narváez*, Eva Grau-Fuentes*, Natalia Morató, Raquel Garzón-Uria and Dolores Rodrigo

Abstract: Rice due to its high carbohydrate content, is an ideal medium for *Bacillus cereus* growth, a spore-producing microorganism. The objective of this study was to determine the antimicrobial activity of a grape extract in combination with heat treatments and different pH against *B. cereus* spores in a rice solution. The survival curves observed were fit to the Weibull survival function, and the values of parameters α and β were calculated.

EMT - Food Science and Technology 2023 116(2)

Contents lists available at ScienceDirect LWT journal homepage: www.elsevier.com/locate/lwt

Unlocking hidden potential of rice bran: Enzymatic treatment for enhancing techno-functional properties

Eva Grau-Fuentes*, Raquel Garzón*, Dolores Rodrigo*, Cristina M. Rosell*

*Institute of Agrochemistry and Food Technology (IATA-CSIC), Ctra del Camino Agrícola Jardines de la Reina, s/n, 46980 Paterna, Valencia, Spain

**Institute of Food and Human Nutrition Sciences, University of Vienna, Vienna, Austria

Abstract: Rice bran is an agricultural by-product with high nutritional value. The objective of this study was to determine the antimicrobial activity of a grape extract in combination with heat treatments and different pH against *B. cereus* spores in a rice solution. The survival curves observed were fit to the Weibull survival function, and the values of parameters α and β were calculated.

Journal of Functional Foods 109 (2020) 105649

Contents lists available at ScienceDirect Journal of Functional Foods journal homepage: www.elsevier.com/locate/jff

Understanding the marketed plant-based beverages: From ingredients technological function to their nutritional value

Eva Grau-Fuentes*, Raquel Garzón*, Cristina M. Rosell*

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**Institute of Food and Human Nutrition Sciences, University of Vienna, Vienna, Austria

Abstract: Plant-based beverages are an increasingly popular food product. The main objective of this study was to determine the market size of plant-based beverages in the European Union (EU) and to analyze the nutritional value of these products. The results showed that the market size of plant-based beverages in the EU increased from 2010 to 2019 by 20.6% (from 1.9 to 5.9 billion euros). The main countries in which these products are consumed are France, Germany, Italy, Spain, and the United Kingdom. The nutritional value of plant-based beverages is mainly influenced by the type of plant used and the processing conditions. These comprehensive study sheds new understandings regarding vehicle insights and the optimisation of the plant-based beverage market.

EMT - Food Science and Technology 175 (2023) 154461

Contents lists available at ScienceDirect LWT journal homepage: www.elsevier.com/locate/lwt

Evaluation of the antimicrobial activity of grape extract against *Bacillus cereus* in rice

Eva Grau-Fuentes*, María del Mar Manzanaro*, Antonio Martínez*, Raquel Garzón*

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**Institute of Food and Human Nutrition Sciences, University of Vienna, Vienna, Austria

Abstract: *Bacillus cereus* is a foodborne pathogen that can cause food poisoning and foodborne disease. The main source of this infection is rice. The aim of this work was to evaluate the antimicrobial activity of grape extract against *B. cereus* in rice. The results indicate that antimicrobial activity of grape extract was dependent on temperature, pH and grape extract concentration. The results also show that the antimicrobial activity of grape extract increased with increasing temperature and pH tested. Inactivation curves of *B. cereus* under grape extract exposure was fitted to a Weibull survival function. The results show that the antimicrobial activity of grape extract increased with increasing temperature and grape extract concentration, while the inactivation value in other words, the time required to inactivate 90% of the *B. cereus* cells decreased with increasing temperature and grape extract concentration. This segment as a great opportunity to create PBPs using different grape varieties.

Journal of Food Protection 85 (2022) 106649

Contents lists available at ScienceDirect Journal of Food Protection journal homepage: www.elsevier.com/locate/jfp

One of the main factors contributing to *B. cereus* outbreaks related to cooked rice is poor cooling, or storage at room temperature for a prolonged period of time, which favours the multiplication of the bacteria and toxins (Gómez et al., 2019). The main source of this infection is rice, which is a staple food for almost half the world population (Elli & Huang, 2021). However, it is also frequently involved in foodborne illness around the world. Currently, followers of plant-based diets and people concerned about environmental issues are turning to plant-based products (Gómez et al., 2021; Selli et al., 2016; Shao & Atkinson, 2023), thus this segment as a great opportunity to create PBPs using different grape varieties.

How (*Opuntia sativa* L.) is a basic cereal, widely consumed by the global population due to its abundant nutrients and relatively low price. It is a traditional food in Mexico and is consumed by almost half the world population (Elli & Huang, 2021). However, it is also frequently involved in foodborne illness around the world. Currently, followers of plant-based diets and people concerned about environmental issues are turning to plant-based products (Gómez et al., 2021; Selli et al., 2016; Shao & Atkinson, 2023).

After heating, the spores that have survived the process can germinate and produce vegetative cells. *B. cereus* can grow at 20 °C and 37 °C, but it cannot grow at 0 °C (Collins et al., 2013). During standard cooking conditions, 2.3 decimal log reductions in the initial concentration of *B. cereus* spores can be achieved by heating the inoculated temperature and grape extract concentration, while the inactivation value in other words, the time required to inactivate 90% of the *B. cereus* cells decreased with increasing temperature and grape extract concentration. This segment as a great opportunity to create PBPs using different grape varieties.

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Conclusion

The research highlights the efficacy of integrating **innovative and sustainable technologies** in the food industry, including **natural antimicrobials**, **enzymatic modifications**, and **high pressure processing**. These approaches enhance the microbiological safety, nutritional quality, and functional properties of rice and rice by-products.



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thank you!