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TRACING RICE AND VALORIZING SIDE STREAMS ALONG
MEDITERRANEAN BLOCKCHAIN

28.10.2024



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Published on 27/07/2024

At the "International Conference on Sustainable Foods - Achieving the Sustainable Development Goals" (<https://icsf.morecolab.pt/>), held in Bragança, Portugal, on July 24th and 25th...

Phenolic characterization of Mediterranean Rice Varieties and development of predictive models by NIR and FTIR

Ana M. Rodríguez¹, Fátima J. Gonçalves¹, Cristina Pereira¹, Pedro Sampaio¹, Carla Brites¹, Teresa Serra¹, Maria Raulino Bronze^{1,2}

¹IBET - Instituto de Biologia Experimental e Tecnológica, Estrada da Costa 1, 2749-016 Alameda, Portugal; ²PRIMA - Portuguese Rice Association, Rua da Liberdade 10, 1000-001 Lisboa, Portugal

INTRODUCTION

Rice is a staple food for more than half of the world's population, with 90 % of the total global production originating from Asia. However, the harvested rice seeds, and subsequent processed products are highly prone to adulteration due to the difficulty to differentiate rice varieties based solely on visual observation.

METHODS

High-performance liquid chromatography coupled to diode array, fluorescence, and electrochemical detector (HPLC-DAD-ED) was used for the quantification of phenolic compounds in brown rice varieties. Phenolic compounds were extracted as in Shao et al. (2014). The antioxidant activity was determined using the Oxygen Radical Absorbance Capacity (ORAC) assay. Near infrared (NIR) and Fourier Transform-Infrared Spectroscopy (FTIR) were used as fast-screening methodologies to develop predictive models of parameters related to rice quality and authenticity. Spectral data was normalized using Min-Max and standard normal variate (SNV) and pre-processed using the 2nd derivative.

RESULTS

Phenolic characterization and antioxidant activity of Mediterranean rice varieties

Fig. 1 - Total phenolic compounds of 22 brown rice varieties (n=3). Fig. 2 - Antioxidant activity of 22 brown rice varieties (n=3).

Rapid screening methods

FT-Infrared Spectroscopy (FTIR) and **Near Infrared Spectroscopy (NIR)** were used to develop predictive models.

• Rice varieties with highest concentration of total phenolic compounds also showed higher antioxidant activity capacity.

• The insoluble phenolic fraction consistently demonstrated higher antioxidant activity compared to the soluble fractions.

CONCLUSIONS

The characterization of rice varieties and the development of predictive tools for the discrimination and selection of Mediterranean rice varieties are of utmost importance in rice breeding allowing to speedily evaluate important chemical parameters with nutritional and health impact to the consumer.

PCA analysis of FTIR spectral data allowed to discriminate between brown and white rice but PCA analysis of NIR spectral data further allowed to discriminate between rice types (explained variance of 70.3%).

References: Serra et al. Food Chem, 2016, 183:196-6. doi:10.1016/j.foodchem.2015.07.042.

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UNDERSTANDING THE MARKETED PLANT-BASED BEVERAGES: FROM INGREDIENTS TECHNOLOGICAL FUNCTION TO THEIR NUTRITIONAL VALUE

Eva Grau-Fuentes¹, Dolores Rodrigo¹, Raquel Garzón¹, Cristina M. Rosell^{1,2}

¹Institute of Agrochemistry and Food Technology (IATA-CSIC), Carretera del Castellón s/n, 46100 Burjassot, Valencia, Spain; ²Department of Food and Human Nutritional Sciences, University of Minnesota, Wisconsin, Canada

INTRODUCTION

The global plant-based beverage (PBB) market is rapidly expanding, projected to grow from USD 8 billion in 2017 to an estimated USD 21.7 billion by 2023. This growth is driven by a long history of PBB consumption in Eastern and Western cultures, with notable examples like Kombucha, Miso, and soy milk, initially marketed as a lactose-intolerant alternative, and beverages made a remarkable transition from local to global markets. Moreover, the rising popularity of plant-based diets and environmental concerns is fueling interest in PBBs sourced from various different plants, including cereals, legumes, nuts, seeds, and pseudocereals, all of which sharing common processing steps. Consumer preferences prioritize better-tasting, visually appealing, and nutritional enhancement, micronutrient fortification, and bioactive compounds are crucial. However, nutritional compositions exhibit substantial variability.

OBJECTIVE

Identifying trends in PBB composition, aiding scientifically informed PBB development amid the growing demand for alternative plant sources.

MATERIAL AND METHODS

From May to August 2021, 306 plant-based beverages (PBB) were collected from European and North American grocery stores, encompassing both retail and restaurant PBB brands. The focus was on PBB derived from aqueous extracts, not the mineral supplements. Samples included everything PBB labels for composition and nutritional facts, excluding those missing such information. Ingredients were categorized into raw materials, oils, gums, salt, and plant-based proteins. Principal Component Analysis (PCA) was used to differentiate beverages based on nutritional patterns and regions, and an online plot was generated with the main ingredients to identify processing trends. Data processing tool included: Excel 2019, StatSoft (version 12), and for graphed included: @Vizier 4.0.0.

RESULTS

Fig. 2 - Principal component analysis of PBB that included all the variables involved (ingredients in the formulation and nutritional facts). Identified clusters based on their raw materials, separated colored in the graph.

An analysis of 306 plant-based beverages (PBB) identified key ingredients as water, plant-based materials, and occasionally oil and gums (Figure 1). Vegetable oils, mainly sunflower (76.12%) or rapeseed (11.46%), were common. Blended PBB often omitted added oil (80%), being popular, especially in non-cereal PBB. Principal Component Analysis (PCA, Figure 2) revealed distinct PBB clusters based on nutrition, raw materials, oil, hydrocolloids, and salt, reflecting evolving formulations to meet consumer demands for healthier, diverse options (46.6% of variance explained).

CONCLUSIONS

Plant-based beverages, enriched with diverse plant-based raw materials, adapt to nowadays consumer's demands, significant choice impacts nutrition, with room for lower salt and oil, and higher fiber content. Public education on label reading is essential for nutritional transparency and to understand the differences among brands.

Fig. 3 - Alluvial plot for the main ingredients of PBB. Relationship and frequency between the type of oil, raw materials and hydrocolloids included in the labels of the marketed PBB.

TO READ THE COMPLETE ARTICLE

REFERENCES: Grau-Fuentes, E., Rodrigo, D., Garzón, R., & Rosell, C. M. (2023). Understanding the marketed plant-based beverages: from ingredients technological function to their nutritional value. *Journal of Functional Foods*, 105, 105805.

CONTACTS: eva.grau@iata.csic.es; rosell@umn.edu

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ENHANCING MOLECULAR SCREENING OF HIDDEN INSECT INFESTATION IN RICE GRAINS BY COI BARCODING: PRIMER PERFORMANCE AND LIMIT OF DETECTION

Ana Maria Campos¹, Inês Gonçalves de Sousa², Carina Almeida¹, Carla Brites¹

¹National Institute for Agricultural and Veterinary Research (INIAV), Oeiras, Portugal; ²LEAF - Laboratory for Process Engineering, Environment, Biotechnology and Energy, Faculty of Engineering, University of Porto, Portugal

INTRODUCTION

Infestations by *Sitophilus oryzae* and *Sitophilus zeamais* are one of the main reasons for quantity and quality loss during rice storage. This hidden insect infestation in rice grains poses a significant challenge to both producers and consumers across the globe and has far-reaching implications for food security, economic stability, and public health. These genetically close insect species are particularly adapted to attack rice grains and spend a considerable part of their life cycle, including the entire larval feeding period, inside them [1], representing the hidden infestation that visual inspection cannot successfully detect. They do this by creating an entrance hole, covering it after entry, and then, after the pupation process [2,3] an exit hole is made, from which it then emerges the adult insect [4,5].

OBJECTIVES

The main goal of this study is to develop a fast molecular detection method, such as a multiplex real-time polymerase chain reaction (qPCR) to detect specifically and efficiently hidden infestation in stored rice for minimization purposes and two activities were performed:

1. To verify primer performance, by analyzing its efficiency.
2. Determine the Limit of Detection (LoD) of the qPCR alone.

METHODS

PRIMERS AND PROBES DESIGN: COI Barcode region (comparting DNA sequences from GenBank®).

MORPHOLOGICAL IDENTIFICATION OF ADULT INSECT SPECIES BY GENTALIA OBSERVATION: *S. oryzae* and *S. zeamais*.

DNA EXTRACTION: Grinding in a mortar, Purified DNA.

RT-qPCR - PRIMER EFFICIENCY AND LOD ASSAYS: DNA quantification (Nanodrop), DNA amplification and analysis of results.

Sequence alignment and design of primers and probes using Geneious Prime.

Sitophilus oryzae primer efficiency plot: Efficiency ≈ 95%.

Sitophilus zeamais primer efficiency plot: Efficiency ≈ 92%.

Sitophilus oryzae LoD plot: LoD=0.0025 ng of DNA per µL.

Sitophilus zeamais LoD plot: LoD=0.005 ng of DNA per µL.

RESULTS AND DISCUSSION

Most of the current methods to detect hidden infestation in grains are obsolete and time-consuming, so it is important to develop an efficient and sensitive qPCR method. These results led us to conclude that the designed primers were efficient, and the method is highly sensitive. However, more studies are needed to quantify the LoD that reflects the early stages of hidden infestation in rice grains.

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REFERENCES: Campos, A. M., et al. (2023). Enhancing molecular screening of hidden insect infestation in rice grains by COI barcoding: primer performance and limit of detection. *Food & Health Discussion*, IBET, Portugal.



Design thinking for food: Remote association as a creative tool in the context of the ideation of new rice-based meals

Ana Castanho¹, Manuela Guerra¹, Carla Brites^{1,2}, Jorge C. Oliveira³, Luís M. Cunha^{4,5}

¹ Unidade de Nutrição, ISEC, Faculty of Sciences, University of Aveiro, Portugal
² ISEC - Instituto Nacional de Investigação Agrária e Veterinária, Lisboa, Portugal
³ ISEC-ITIC, Faculdade de Engenharia e Tecnologia da Universidade Nova de Lisboa, Portugal
⁴ Green e Cities, Portugal
⁵ Green ITIC, Portugal e National University of Ireland, Cork, Ireland

ARTICLE INFO
Keywords: Alternative uses task, Creativity, Idea generation, Remote association, Remote association task, Rice-based products

ABSTRACT
 Portugal is the greatest European rice consumer. Thus, incorporating whole rice and rice bran in innovative rice products is challenging. An experimental method based on the creativity association theory was applied. A group of nine students performed simple brainstorming to generate recipe ideas. Following the Design Thinking approach, a group of nine chefs prepared a meal to generate meals related to rice crops, working as a stimulus for a group of 14 students to generate recipe ideas. All ideas from both groups were evaluated by the chefs. The inclusion of animal led to more creative ideas from young aspiring chefs.

1. Introduction

Rice (*Oryza sativa* L.) is the staple food of most of mankind, with a world per capita consumption of about 80.6 kg/year. The European average value of consumption is more modest, just 6.7 kg (per year), registered between 2015 and 2018. Within this region, Portugal has the highest consumption, with a per capita average of about 16.1 kg/year (FAO, 2019). The importance of rice in Portuguese gastronomy can be perceived not only by the consumption data, but also by analyzing rice preparations, which comprise many rice-based dishes (Cunha et al., 2013). Such dishes span from plain white rice to more elaborate rice dishes, presented as a side dish or even as a main course, and incorporating vegetables, legumes, fish, shellfish or all types of meats (poultry, lamb, pork or beef) (Cunha et al., 2013).

Despite the benefits of whole rice (Cunha et al., 2013), traditional rice preparation are made with milled rice kernels, with the remaining rice bran being incorporated into animal food (Zhu et al., 2013). However, rice bran is known to possess several health benefits (Chakravorty et al., 2012; Ramamoorti et al., 2019; Yang et al., 2017; Hwang et al., 2013; Kozma et al., 2013).

Design Thinking (DT) can be considered a multidisciplinary and user-centered method directed at innovation, as popularized by IDEO and Stanford d.school (Bruscia, 2008; Brown and Wyatt, 2005; Kelley,

2001). However, it was at first, a part of the designer's activity discussed by design theorists and mainly focused on what is design and how design is a discipline that uses different types of cognitive processes to think about ill-defined problems (Cross, 1992; Lawson, 2006; Rittel and Weber, 1997; Sellen, 1993; Smith, 1996). DT as a method has been used in different ways, regarding the number of iterative process steps and their terminology (Pruichin et al., 2018) according to Hwang et al. (2019). The most employed methods are the ones from IDEO (Inspiration, Ideation, Implementation), Stanford d.school (Empathize, Define, Sketch, Prototype and Test) and IBM (Understand, Explore, Prototype, Evaluate).

Although the DT approach has been applied broadly, its use in food innovation is scarce (Dixon, 2013). Dixon (2015), reported the positive role of rapid prototyping in a food DT experience where chefs and nutrition worked together. Ivancic et al. (2020) integrated applied a DT methodology in a project-based learning experiment with students to create food products based on consumers' needs.

The brainstorming technique was first introduced by Osborn (1953), who described it as a team exercise performed in two phases: free-associating ideas generation, and discussion (idea interpretation). When describing the IDEO design methodology, Kelley (2001) emphasizes the brainstorming techniques as the key to idea generation and creating a list of rules to give the "perfect brainstorm".

QUALIDADE E SEGURANÇA ALIMENTAR



A GERMINAÇÃO E A FERMENTAÇÃO DO ARROZ PARA AUMENTAR O SEU VALOR NUTRICIONAL

Os processos de germinação e fermentação estão a ser estudados para aumentar a concentração de compostos bioativos (γ-orzonal e ácido γ-aminobutírico) e potenciar o valor nutricional e a utilização do arroz.

Cristiana Pereira^{1,2,3}, Ana Castanho⁴, Manuela Lago^{5,6}, Carla Brites⁷

¹ Instituto Nacional de Investigação Agrária e Veterinária
² Departamento de Ciências da Terra, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa
NIWA
³ GreenITIC, Portugal
⁴ GreenITIC, Portugal
⁵ GeolBioTec Research Center, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa
⁶ Green-IT Bioresources for Sustainability, ITQB NOVA

Relationship Between Physicochemical and Cooking Quality Parameters with Estimated Glycaemic Index of Rice Varieties

Cristiana L. Pereira^{1,2,3}, Inês Sousa^{1,2,3}, Yvanda M. Lourenço^{4,5}, Pedro Sampaio^{1,2,6}, Raquel Gáston^{6,7}, Cristina M. Rosell^{6,7} and Carla Brites^{1,8,*}

¹ National Institute for Agricultural and Veterinary Research (INIAV), I.P., Av. da República, 2780-157 Oeiras, Portugal
² Department of Earth Sciences, NOVA University of Lisbon, 2829-516 Caparica, Portugal
³ Linking Landscapes, Environment, Agriculture and Food (LEAF) Research Centre, Tapada da Ajuda, 1349-017 Lisboa, Portugal
⁴ Centre for Mathematics and Applications (NOVA MMA) and Department of Mathematics, NOVA SSE, 2829-516 Caparica, Portugal
⁵ Computação e Cognição Centraliza nos Pressos, BioRG+—Biomedical Research Group, Lusófona University, Campo Grande, 376, 1700-019 Lisboa, Portugal
⁶ Institute of Agrochemistry and Food Technology (IATA-CSIC), 4080 Palencia, Spain
⁷ Food and Human Nutrition Department, University of Manitoba, Winnipeg, MB R2S 2J6, Canada
⁸ GREEN-IT Bioresources for Sustainability, ITQB NOVA, Av. da República, 2780-157 Oeiras, Portugal
 * Correspondence: carla.brites@mdpi.com

Abstract: Rice is a significant staple food in the basic diet of the global population that is considered to have a high glycaemic index. The study of the physical and chemical parameters in rice that are related to the starch digestion process, which allows us to quickly predict the glycaemic index of varieties, is a major challenge, particularly in the classification and selection process. In this context, and with the goal of establishing a relationship between physicochemical properties and starch digestibility rates, thus shedding light on the connections between quality indicators and their glycaemic impact, we evaluated various commercial rice types based on their basic chemical composition, physicochemical properties, cooking parameters, and the correlations with digestibility rates. The resistant starch, the gelatinization temperature and the retrogradation (setback) emerge as potent predictors of rice starch digestibility and estimated glycaemic index, exhibiting robust correlations of $r = -0.80$, $r = -0.86$, and $r = -0.70$ ($p < 0.05$), respectively. Among the rice types, Long B and Basmati stand out with the lowest estimated glycaemic index values (68.44 and 66.50, elevated levels of resistant starch, gelatinization temperature, and setback values. Furthermore, the Long B showcases the highest amylose, while the Basmati with intermediate, revealing intriguingly strong grain integrity during cooking, setting it apart from other rice varieties.

Keywords: rice commercial types; physicochemical parameters; cooking parameters; glycaemic index

1. Introduction

Rice holds a significant position among cereal crops, serving as a crucial energy source and being widely integrated into the diets of populations. Ensuring the quality of rice grains is of paramount importance due to its impact on consumer preferences, acceptance, and its influence on economic value [1]. The evaluation of grain quality encompasses a spectrum of factors, including its physical attributes (such as form, size, and colour), its fundamental chemical composition (including protein, lipid, and fibre content), and its physicochemical characteristics (such as amylose content, gelatinization temperature and viscosity profiles). The cooking and eating quality of rice is directly affected by amylose content with impact on the water absorption during cooking [2]. In the grain elongation ratio, in the final hardness of the cooked grain [3], in the gelatinization temperature and in the rate of retrogradation [4].



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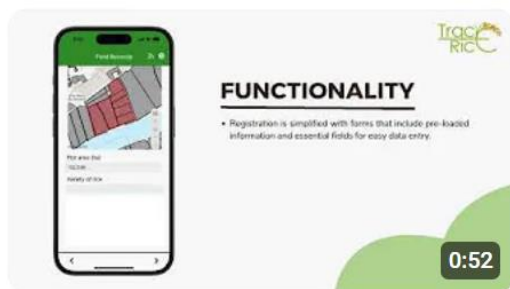
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WP 6

thank you!