

Unlocking the potential of rice bioactive compounds in diabetes control

Cristiana Pereira¹, Ana Filipa Raimundo^{2,3,4}, Regina Menezes^{2,3,5}, Vanda Lourenço⁶, Carla Brites^{1,7*}

¹INIAV- Instituto Nacional de Investigação Agrária e Veterinária, Oeiras, Portugal; ²CEDOC, Centro de Estudos de Doenças Crônicas, Nova Medical School, UNL, Lisboa, Portugal; ³IBET - Institute of Experimental Biology and Technology, Oeiras, Portugal; ⁴ITQB, Instituto de Tecnologia Química e Biológica António Xavier, Oeiras, Portugal; ⁵CBIOS -Universidade Lusófona's Research Center for Biosciences & Health Technologies, Lisboa, Portugal; ⁶Faculty of Sciences and Technology (FCT) & Centre for Mathematics and Applications (CMA), NOVA University of Lisbon, Caparica, Portugal; ⁷GREEN-IT Bioresources for Sustainability, ITQB NOVA, Oeiras, Portugal; *carla.brites@iniav.pt

INTRODUCTION

This study reviewed and evaluated the effects of rice bran bioactive compounds (γ-oryzanol, phytic acid and ferulic acid) on processes associated with diabetes, contributing to the characterization of rice-based foods nutritional quality.

Metabolism and bioactivity towards diabetes

Intestinal glucose transporters, and amyolytic digestive enzymes
Blood glucose
Pancreatic β-cell functionality

RICE BIOACTIVE COMPOUNDS EFFECTS:

Glycemic index (GI)

Modulation of Glucose Transporters (GLUT2 and SGLT1)

α-amylase and α-glucosidase activities

Islet Amyloid Polypeptide (IAPP) amyloid formation

FERULIC ACID (FA)

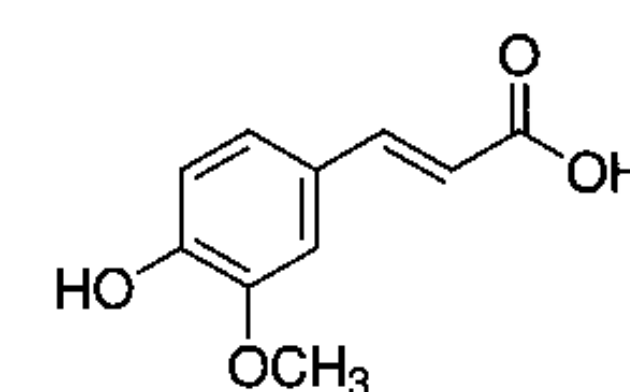
- C57BL/KsJ-db/db diabetic mice; diet supplemented with 0.05 g/kg/day FA, 17 days:
↓ Blood glucose
↑ Plasma insulin

- Caco-2 cells, + 0-0.1 mg/mL FA, 15 min:
↓ Glucose uptake

- *Xenopus laevis* oocytes, + 100-300 μM, 30 min:
Block glucose uptake
↓ GLUT2

- Baker's yeast α-glucosidase 20 μL + 20 μL FA, 30 min:
Inhibition (IC₅₀= 0.8 mg/mL)

- Cell-free, human amylin peptide + 10-40 μM FA, 192 h:
↓ IAPP amyloid formation



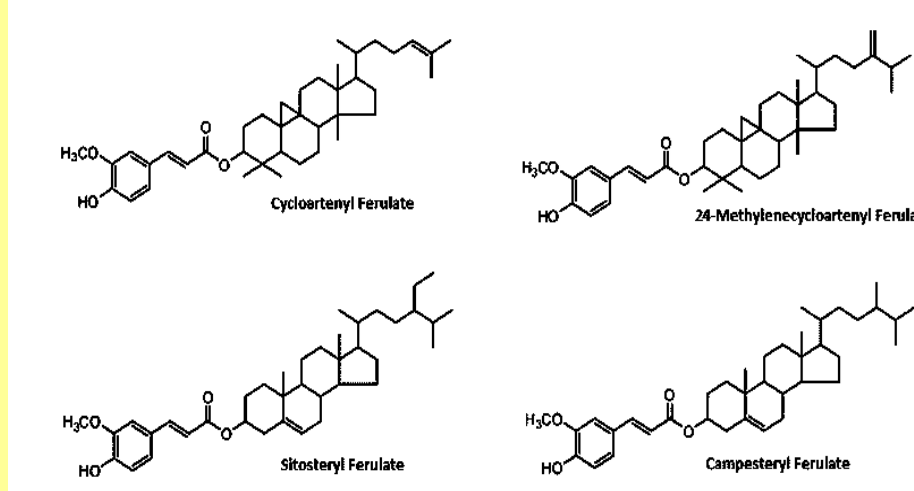
γ-ORYZANOL (GO)

- Streptozocin treated Wistar rats; diet supplemented with 50 and 100mg/kg/day GO from rice bran, 8 weeks:
↓ Serum glucose
↓ Oxidative stress

- 40 μL α-amylase 50 U/mg + 0.5 mL GO + 40 μL of starch 1%:
Inhibition (IC₅₀=0.78 mg/mL)

- 100 μL α-glucosidase 50 U/mg + 5 mg GO, 30 min:
Inhibition (IC₅₀=0.81 mg/mL)

- C57BL/6J mouse, diet supplemented with 320 g/g weight/day GO, 13 weeks:
↓ Pancreatic islet dysfunction
↑ Protection of β-cells against apoptosis



PHYTIC ACID (PA)

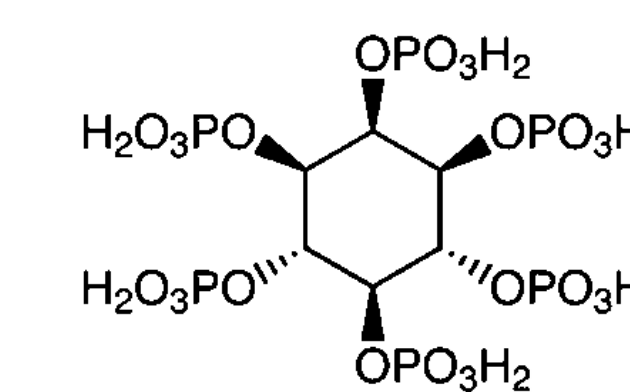
- C57BL/6N mice; 3 g diet/day contained 0.5% PA, 7 weeks:
↓ Blood glucose

- Diabetic KK mice, diet with 0.5-1.0% sodium phytate, 8 weeks:
↓ Blood glucose

- Piglets (Yorkshire-Landrace x Duroc) supplemented with 2 g PA or Na phytate/1 kg diet, 10 days:
↓ Crypt depth in the jejunum
↓ SGLT1 expression in the duodenum, jejunum, and ileum
↓ Nutrient utilization in pigs, which is involved in glucose and Na absorption

- 1 U/mL α-amylase + 0.25 – 8 μg PA/mL, 3 min:
Inhibition (IC₅₀=1.2 g/mL)

- 5–100 μg PA/mL + ~0.1 mL α-glucosidase + starch 0.5%, 60 min:
Inhibition (IC₅₀=3.2 g/mL)



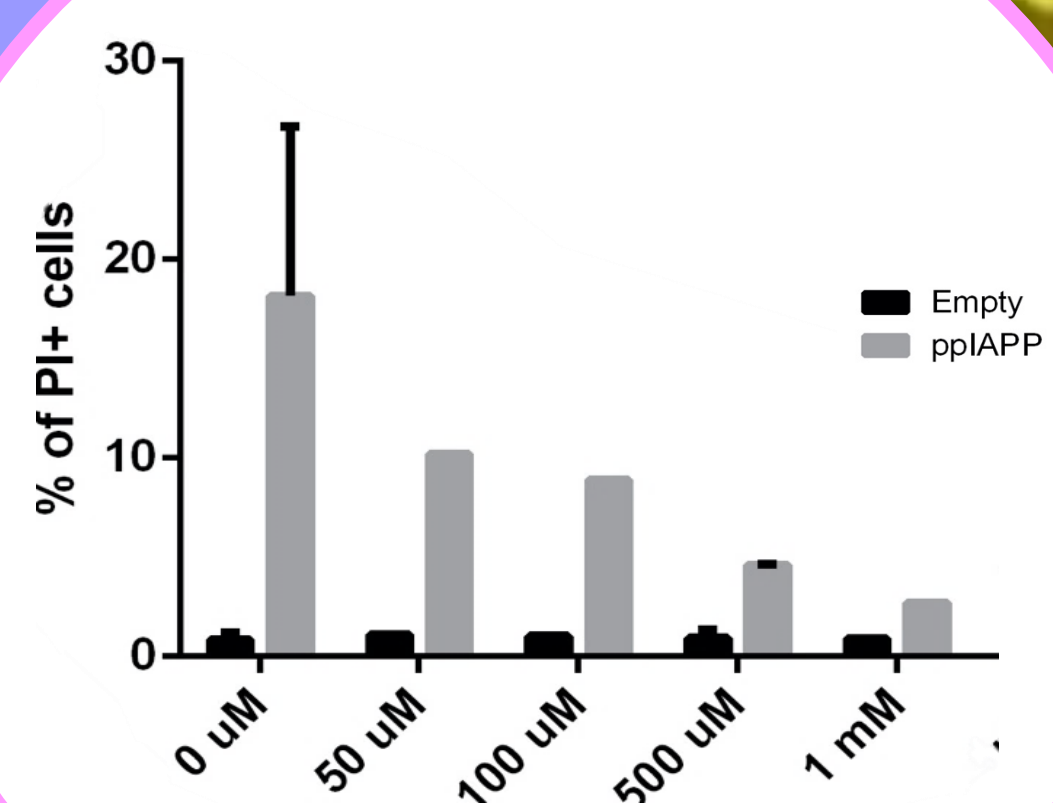
IN VITRO PRELIMINARY ASSAYS:

IAPP AMYLOID FORMATION

Type 2 diabetes mellitus IAPP aggregation → increased β-cell apoptosis

Potential therapeutic target Inhibition of IAPP aggregation

PHYTIC ACID



• **METHODOLOGY:** Evaluation of rice compounds potential to reduce cytotoxicity in yeast strains heterologous expressing human IAPP as measured by flow cytometry using propidium iodide.

• **RESULTS:** Phytic acid at concentrations of 500 μM and 1 mM reduces IAPP cytotoxicity potentially modulating IAPP aggregation.

CONCLUSIONS:

The protective effects of rice bran compounds are mostly related to the reduction of food GI, partially due to the inhibition of α-amylase and α-glucosidase, with implications for the reduction of blood glucose. Ferulic acid stands out as exhibiting bioactive properties towards several processes impacting diabetes, including the potential inhibition of IAPP proteotoxicity. Phytic acid and ferulic acid are suggested to modulate the activity of glucose transporters, whereas γ-oryzanol, bioactivities are associated with the attenuation of β-cell dysfunction. Finally, our preliminary analysis suggest the inhibitory effect of phytic acid against IAPP cytotoxicity.

REFERENCES

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