Unlocking the Potential of Rice: Innovative Extraction Methods and Bioactive Compound Analysis

TRACING RICE AND VALORIZING SIDE STREAMS ALONG MEDITERRANEAN BLOCKCHAIN

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PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

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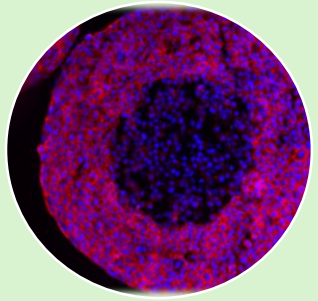
iBET's contribution in TRACE RICE project

Natural Bioactives & Nutraceuticals Area

Valorizing bioactives present in food, natural matrices, and industrial by-products for a healthier and more sustainable future: from extraction to characterization and evaluation of health-promoting effects.

Extraction & Purification

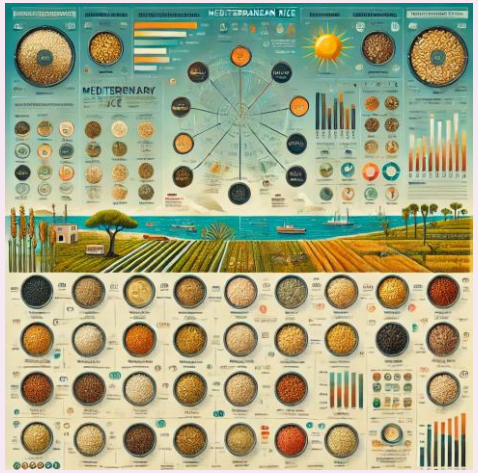
Characterization



Functionality

Activity I:

Characterization of Mediterranean rice varieties



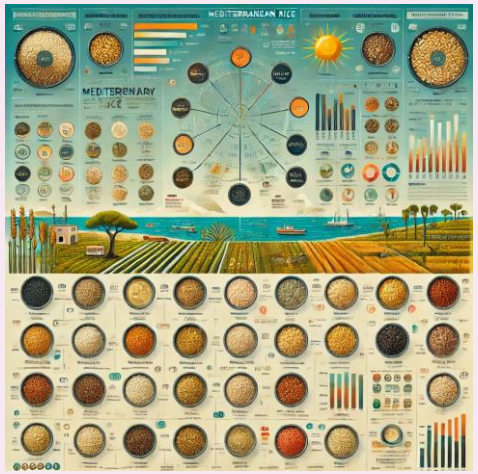
- Chemical characterization
- Antioxidant activity

Activity II:

Valorization of rice by-products

- Green extractions & Chemical characterization
- Bioactivity: Antioxidant activity & Antiproliferative potential

Activity I: Characterization of Mediterranean rice varieties



- Chemical characterization
- Antioxidant activity

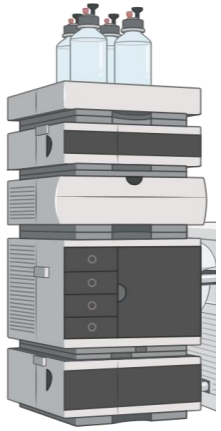
OBJECTIVE

To link the chemical profile of 22 rice varieties with nutritional value and health-promoting bioactivities

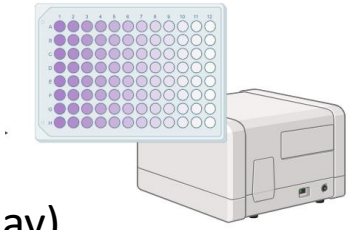
Characterization of Mediterranean rice varieties

22 Mediterranean rice varieties
(cooked brown rice)

- ✓ Total phenolic content (TPC) determined by HPLC-DAD



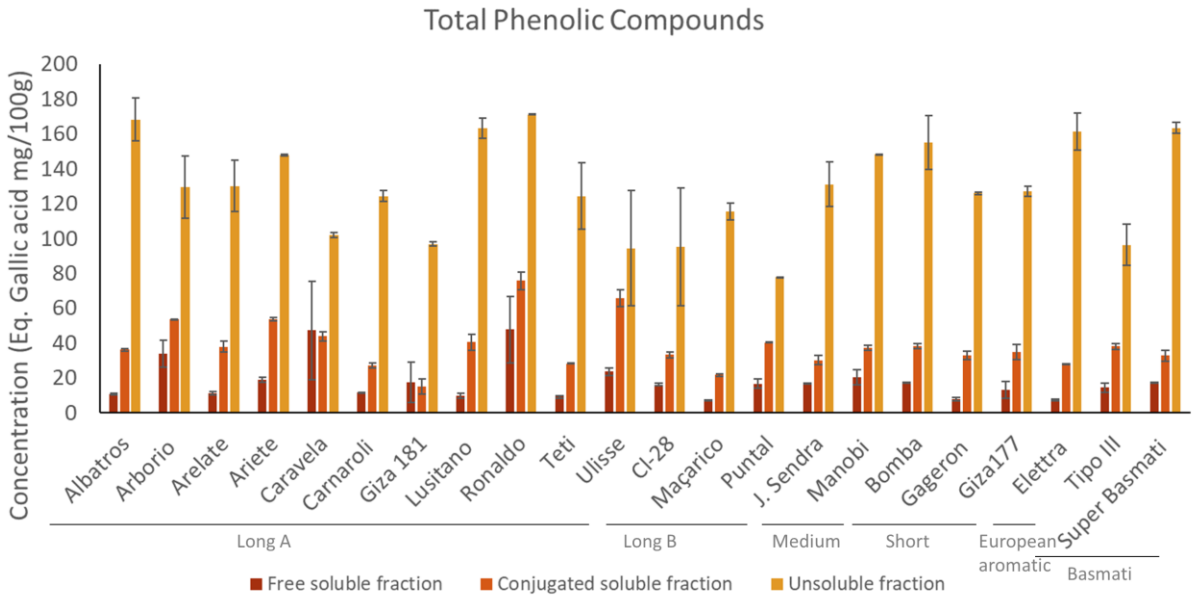
- ✓ Antioxidant activity (ORAC)

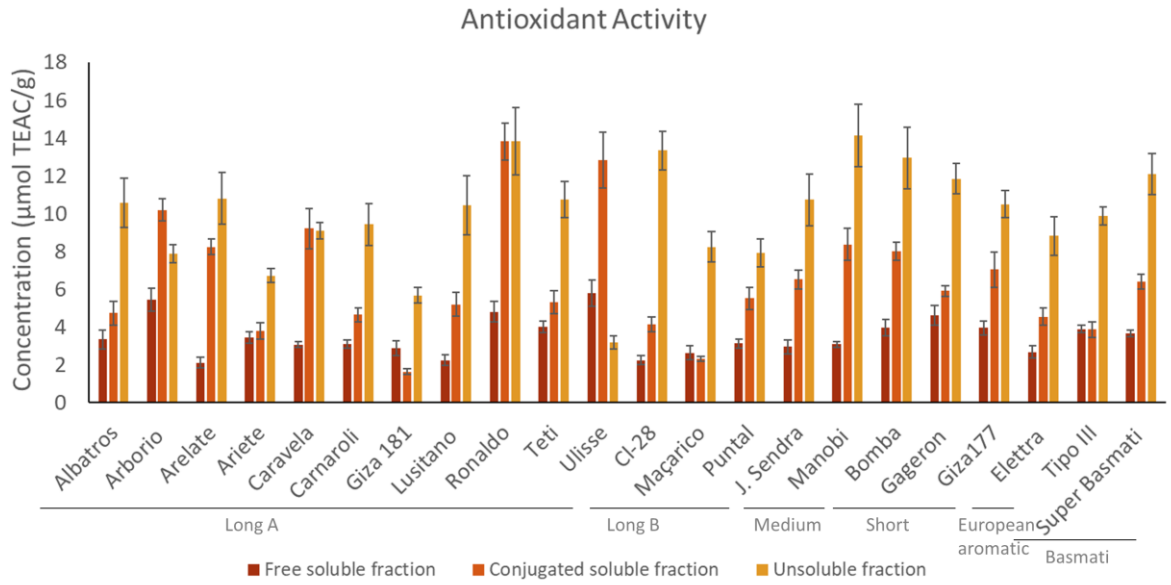


- ✓ Total saponin content (vanillin-sulfuric acid assay)

Characterization of Mediterranean rice varieties

Phenolic compounds possess a high antioxidant and free radical scavenging potential.

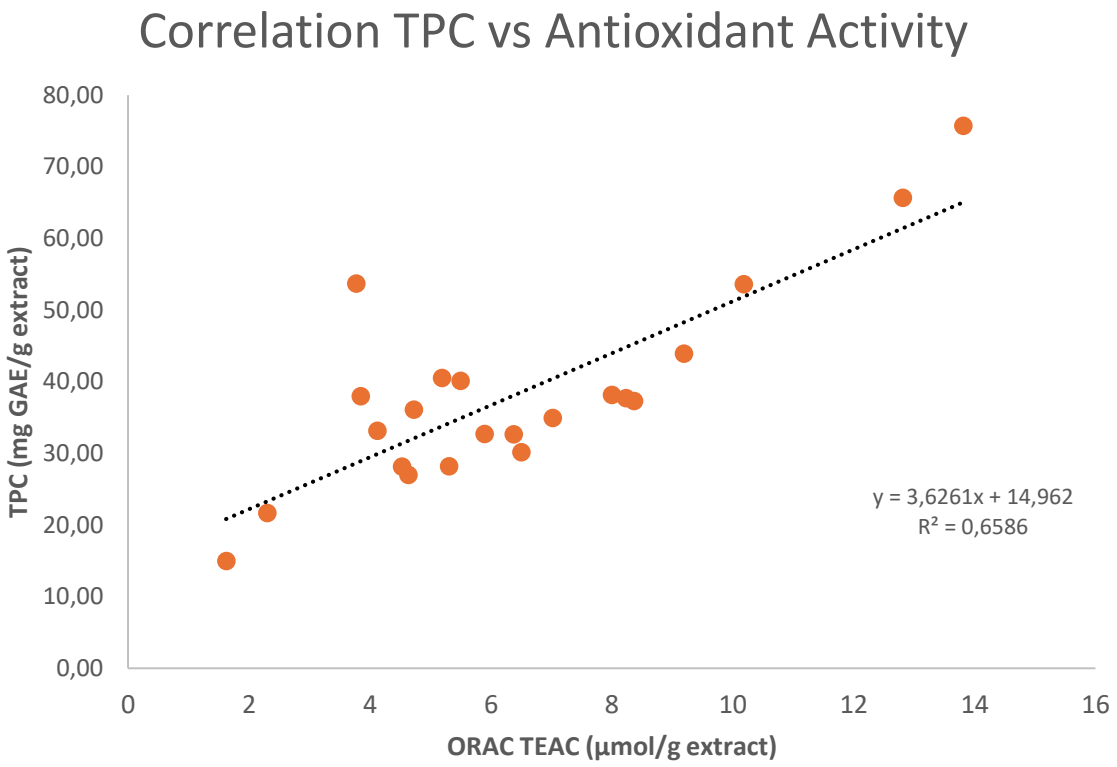




- ✓ No relation could be observed between TPC and AA and rice type
- ✓ The **unsoluble phenolic fraction** consistently demonstrated **higher TPC and AA** compared to the soluble fractions
- ✓ In general, rice varieties with **higher TPC** also showed **higher AA**

Characterization of Mediterranean rice varieties

- ✓ Positive correlation (r^2 = 0.66) between TPC and AA of the conjugated soluble phenolic fraction.

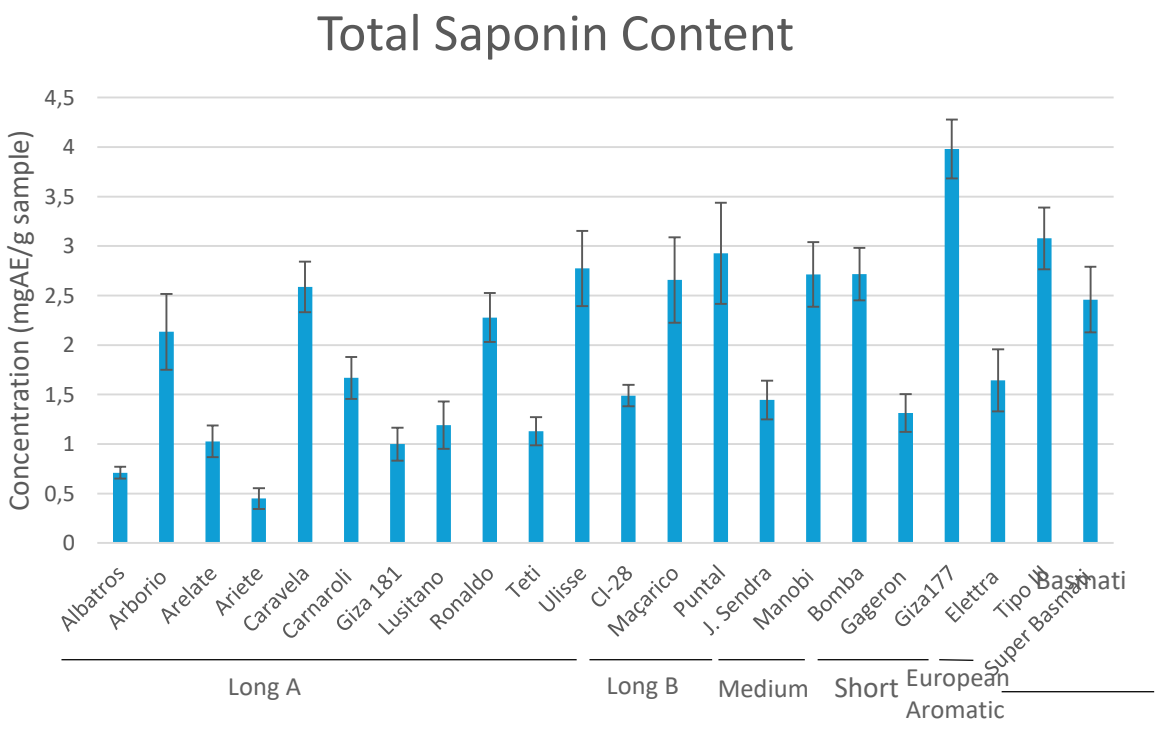


Characterization of Mediterranean rice varieties

Saponins:

☹ Anti-nutrient, bitter, inhibits protein digestibility

☺ Foaming agents, detergents, and emulsifiers; antioxidant, anti-cancer, anti-inflammatory, anti-thrombotic etc.



✓ No relation could be observed between total saponin content and rice type

Activity II:

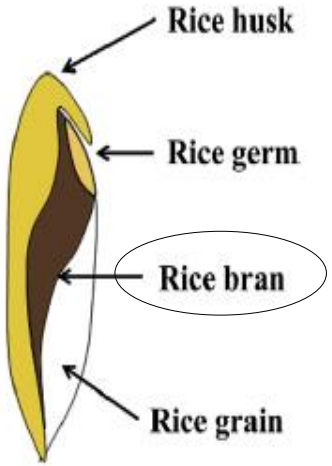
Valorization of rice by-products

- Green extractions & Chemical characterization
- Bioactivity: Antioxidant activity & Antiproliferative potential

OBJECTIVE

To valorize rice by-products through the development of green extraction methods to obtain bioactive rich-extracts

Valorization of rice by-products
Extraction & chemical characterization

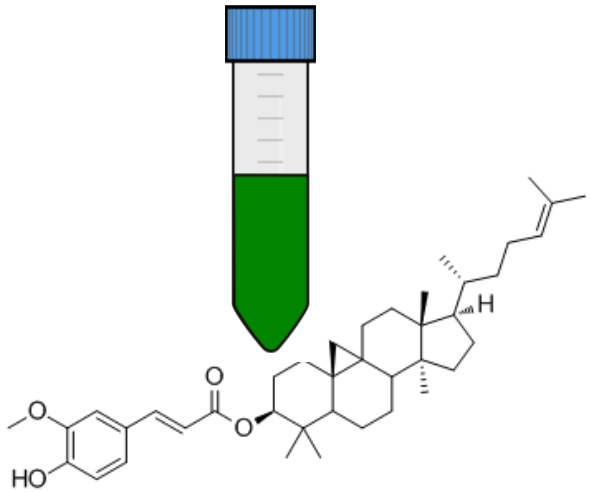


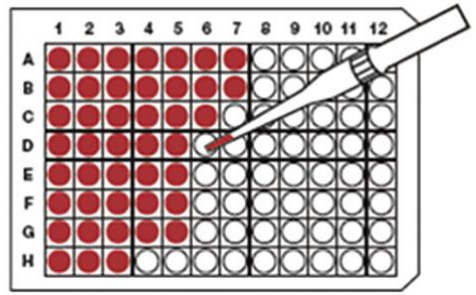
Supercritical CO_2 extraction

- ✓ Temperature (°C)
- ✓ Pressure (bar)

Extract rich in:

- ✓ γ-oryzanol
- ✓ Nutritious unsaturated fatty acids (linolenic, linolenic and oleic acid)





Bioactivity:

- ✓ Antioxidant effect
- ✓ Antiproliferative potential

γ-Oryzanol: Anticarginogenic, anti-inflammatory, antidiabetic and neuroprotective, which are mainly attributed to its antioxidant capacity

Valorization of rice by-products
Extraction & chemical characterization

Raw material: rice bran of japonica (RB)
Fixed parameters:
- Flow rate | 20 g/min
- Time | 180 min
- Raw material | 20 g

Exp No	T (°C)	P (bar)	Extraction yield g (%)	mg/g extract	
				Total FA	γ-Oryzanol
1	40	200	3.01 (15.1 %)	757.64	14.49
2	80	200	2.94 (14.7 %)	772.31	8.94
3	40	500	2.51 (12.6 %)	716.35	24.89
4	80	500	3.64 (18.2 %)	707.41	22.72
5	40	350	2.76 (13.8%)	752.64	20.62
6	80	350	3.53 (17.6 %)	787.22	17.56
7	60	200	3.18 (15.9 %)	723.50	15.4
8	60	500	3.66 (18.3 %)	746.41	18.78
9	60	350	3.36 (16.8 %)	784.49	15.38
10	60	350	3.16 (15.8 %)	782.52	16.75
11	60	350	3.33 (16.7 %)	745.21	19.41

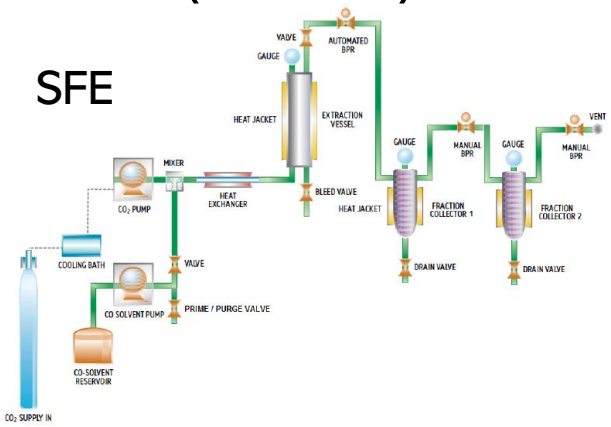
SFE Optimized conditions

Pressure: 500 bar | Temperature : 62 °C

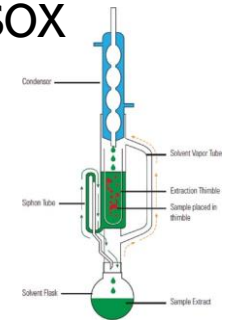
Valorization of rice by-products
Extraction & chemical characterization

Optimized SFE conditions (SFE-opt) vs conventional extraction using Soxhlet with n-hexane (SOX-Hex)

SFE



SOX

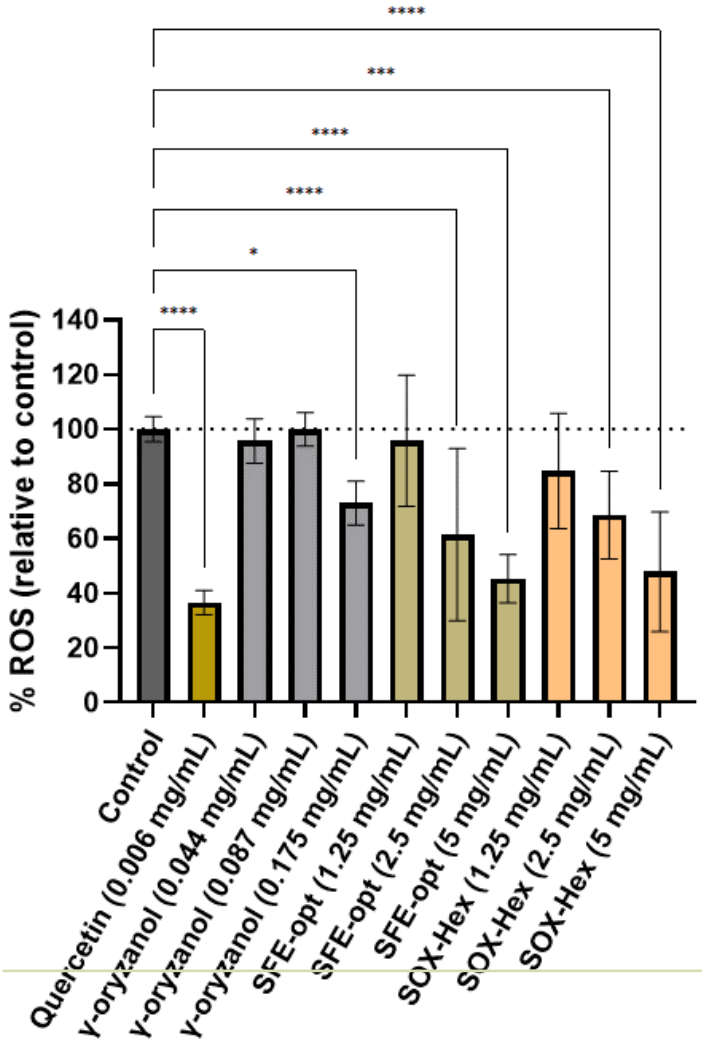


Extract	Extraction yield (%)	Total FA (mg FA/g extract)	γ-Oryzanol (mg/g extract)
SFE-opt	17.3	784.4	36.4
SOX-Hex	18.0	723.3	18.3

- ✓ SFE-opt and SOX-Hex extraction mass yields and FA content are comparable.
- ✓ SFE revealed as the most selective solvent for γ-Oryzanol.

Valorization of rice by-products

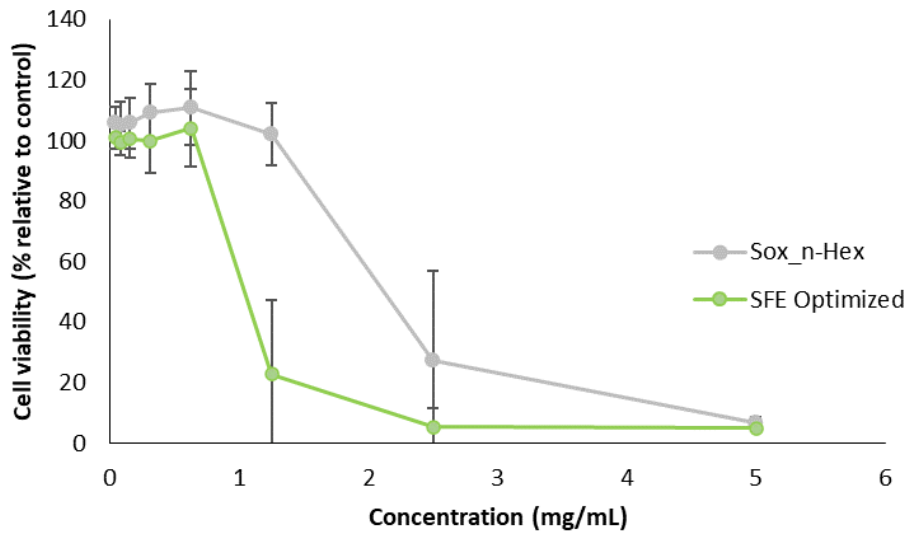
Bioactivity – intracellular antioxidant activity (Caco-2)



- ✓ Inhibition of ROS formation in dose-dependent effect
- ✓ Both extracts presented higher antioxidant capacity when compared with γ-oryzanol → other compounds may be scavenging ROS

ROS: Reactive Oxygen Species

Valorization of rice by-products
Bioactivity – antiproliferative effect (HT29)



Extract	EC50 (mg/mL)
SFE-opt	0.9±0.04
SOX-Hex	1.5±0.19

- ✓ Both extracts inhibited HT29 cell proliferation in a dose-dependent manner.
- ✓ SFE-opt extract showed higher antiproliferative effect

Conclusions

- **No relation** could be observed between total phenolic compound, antioxidant activity and saponin content and rice type or variety.

- SFE is a plausible technology to extract bioactive-rich extracts. Compared to conventional extraction;
  - SFE-opt and SOX-Hex **extraction mass yields** and **FA content** are comparable.
  - Supercritical CO_2 was revealed as the most **selective** solvent for **γ-Oryzanol**.
  - Both extracts presented higher **antioxidant capacity** when compared with γ-oryzanol.
  - SFE-opt extract showed higher **antiproliferative effect.**

Acknowledgements

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iNOVA4Health -Advancing Precision Medicine-

LS4FUTURE

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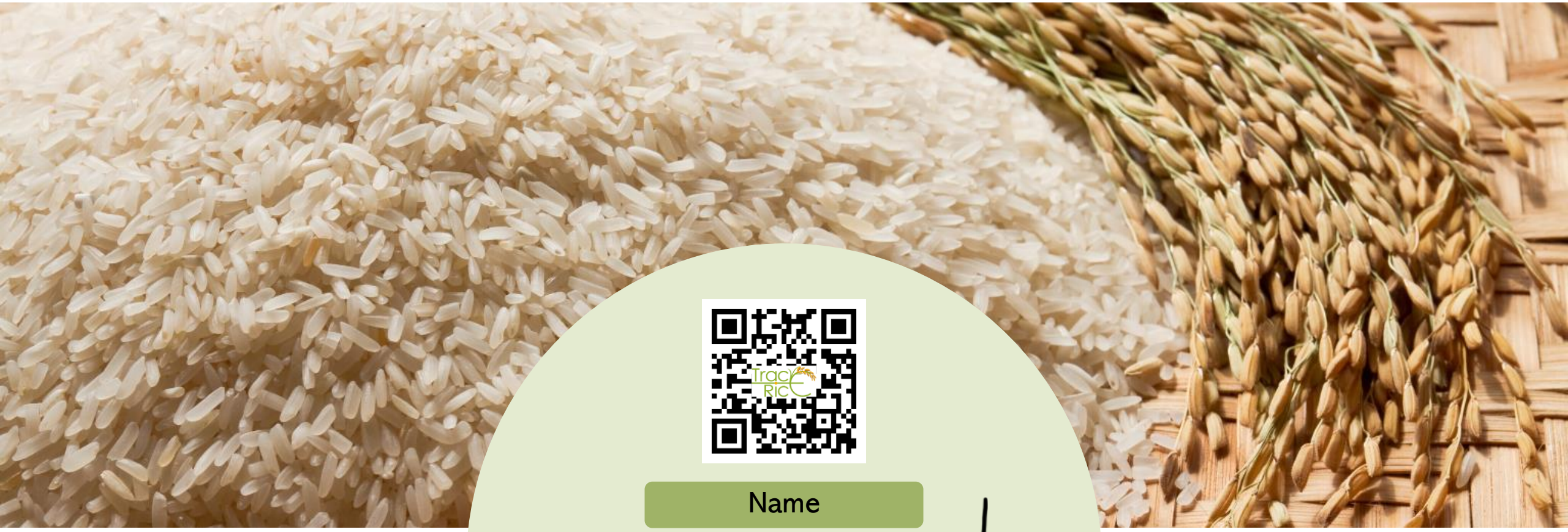

Name

thank you!