

INTERNATIONAL LEGUME SOCIETY

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INSTITUTE OF PLANT GENETICS, POLISH ACADEMY OF SCIENCES

# Third International Legume Society Conference ILS3 2019

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*Legumes for human and planet health*

## **BOOK OF ABSTRACTS**



POZNAŃ 2019

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*This volume has been compiled from files supplied by the Authors*

#### **Cover design**

Akygraf

#### **DTP/Technical Editor**

Reginaldo Cammarano

ISBN 978-83-950380-1-3

#### **Publisher**

Fundacja UAM w Poznaniu  
ul. Rubież 46  
61-612 Poznań, Polska  
e-mail: [fundacjauam@ppnt.poznan.pl](mailto:fundacjauam@ppnt.poznan.pl)

#### **Printed and bound by**

Totem – druk cyfrowy  
ul. Jacewska 12, 88-100 Inowrocław, Polska

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## Healthy novel extruded gluten-free snacks based on legumes and rice: bioactivity evaluation

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Keywords: Bean/rice/carob fruit; extrusion; bioactivity; antitumoral and antimicrobial activity

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Extrusion-cooking technology is a high-temperature and short-time process, necessary to cause structural, physico-chemical and nutritional changes of raw materials, forcing the material to flow under different conditions (temperature, moisture, screw speed, and feed). Rice and legumes have a great potential in the development of healthier gluten-free products than traditional snacks [1].

Rice flour (*Oryza Sativa* L.) has been reported as a good raw material to obtain expanded food products [1]. Dry beans (*Phaseolus vulgaris* L.) are rich in proteins, dietary fibre, complex carbohydrates (leading to low glycaemic index), minerals and numerous phytochemicals endowed with useful biological activities [2]. Carob fruit (*Ceratonia siliqua* L.) is a tree leguminous native to the Mediterranean region. The fortification with carob fruit would provide adequate fibre content and a good amount of bioactive compounds. In previous studies, carob evidenced therapeutical properties against several diseases, such as, regulatory effect in blood glucose level, reduction in low-density-lipoprotein cholesterol in hypercholesterolaemic patients, body weight benefits, and improved digestion, and lipid utilization [3] which were associated with endothelial dysfunction, inflammation, and fibrosis. Furthermore, sirtuin-1 (SIRT1).

In this study, novel gluten-free extruded foods (composed by rice: 50-80%, bean: 20-40%, and carob: 0-10%) were performed using a twin-screw extruder at CARTIF (Valladolid, Spain) and the effects of extrusion were evaluated regarding bioactive properties. Commercial extruded rice was used as external control. Raw materials, non-extruded, and extruded samples were extracted with ethanol/water (80:20, v:v) and purified using C18 SepPak® *Vac 3 cc cartridge* [4,5], in order to obtain an extract rich in bioactive compounds. The cytotoxicity, anti-inflammatory, and antimicrobial activity were evaluated following previously reported procedures [6, 7].

Carob, commercial extruded rice and most of the extruded samples, showed cytotoxicity in the majority of the tumour cell lines tested (HeLa - cervical carcinoma, HepG2 - hepatocellular carcinoma, MCF-7 - breast adeno-

carcinoma, and NCI-H460 - non-small cell lung cancer). While, bean, rice, and most of the non-extruded samples presented no toxicity ( $GI_{50}$  value  $>400 \mu\text{g/mL}$ ) using a non-tumour porcine liver cell culture (PLP2). In general, it was observed that extrusion process improves the cytotoxic potential in the rice-legumes sample mixtures, revealing lower  $GI_{50}$  concentrations (ranging between 115 and 362  $\mu\text{g/mL}$ ). The anti-inflammatory activity revealed a high heterogeneity, presenting bean and carob samples, the highest activity in comparison to the extruded samples. Concerning the antimicrobial activity, which was tested using a panel of multi-resistant isolated clinical strains, a low potential was observed, with non-extruded and extruded samples revealing higher values of minimum inhibitory concentration (MIC) and minimal bactericidal concentrations (MBC).

In conclusion, rice-legumes flours, rice blends, beans, and carob fruits are a great alternative for the development of new gluten-free snacks products, in a market dominated mainly by cereals, due to the presence of different bioactive compounds, such as phenolic compounds, which can give healthier benefits to the consumers.

**Acknowledgments:** The authors are grateful to FCT, Portugal and FEDER under Program PT2020 for financial support to CIMO (UID/AGR/00690/2013), L. Barros and R. Calhelha contracts. The authors are also grateful to FEDER-Interreg España-Portugal programme for financial support through the project 0377\_iberphenol\_6\_E, to the Spanish Ministry of Economy and Competitiveness (Project RTA2012-00042-C02) and INIA for the financial support of C. Arribas.

- [1] Alam MS, Kaur J, Khaira H, Gupta K. *Crit Rev Food Sci Nutr.* 2016;**56**(3):445–73.
- [2] Pedrosa MM, Cuadrado C, Burbano C, Muzquiz M, Cabellos B, Olmedilla-Alonso B, et al. *Food Chem* 2015;**166**:68–75.
- [3] Valero-Muñoz M, Martín-Fernández B, Ballesteros S, Lahera V, de las Heras N. *J Nutr.* 2014;**144**(9):1378–84.
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