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Perspectives of lupine wholemeal protein and protein isolates biodegradation

Elena Bartkiene,[1]* Vytaute Sakiene,[1] Vita Lele,[1] Vadims Bartkevics,[2,3] Janis Rusko,[3] Claudia Wiacek,[4] Modestas Ruzauskas,[1] Peggy G. Braun,[4] Paulius Matusevicius,[1] Zenon Zdunczyk,[5] Przemysław Zdunczyk[5] & Jerzy Juskiewicz[5]

1 Lithuanian University of Health Sciences, Tilzes g. 18, LT-47181 Kaunas, Lithuania
2 University of Latvia, Jelgavas iela 1, LV-1004 Riga, Latvia
3 Institute of Food Safety, Animal Health and Environment, Lejupes iela 3, LV-1076 Riga, Latvia
4 Institute of Food Hygiene, Universität Leipzig, An den Tierkliniken 1, 04103 Leipzig, Germany
5 Department of Biological Analysis of Food, Institute of Animal Reproduction and Food Research of the Polish Academy of Sciences, 10-747 Olsztyn, Poland

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Summary Lupine (*Lupinus angustifolius* L.) protein (in wholemeal and protein isolates) was biodegraded using *Pediococcus acidilactici* in submerged and solid-state fermentation conditions. The changes in the molecular weight of lupine protein fractions, amino acid (AA) profile, biogenic amine formation, antimicrobial and antioxidant properties, and protein digestibility *in vitro* and *in vivo* (in Wistar rats) were evaluated. After biotreatment, lower molecular weight peptides (from 10 to 20 kDa) were established, and the free AA content increased. Biodegradation improved the antioxidant properties, modulated the antimicrobial properties, and led to higher *in vitro* and *in vivo* digestibility and functionality of the lupine in treated rats (significant increase in body weight of Wistar rats, and increased acetic acid concentration and lowered *Escherichia coli* count in the caecum). Overall, the biodegradation of lupine protein can transform the plant protein, producing enhanced functionality and bioavailable products.

Keywords Antimicrobial properties, antioxidant properties, biogenic amines, digestibility, lupine protein, protein biotransformation, solid-state fermentation.

Introduction

Lupine (*Lupinus angustifolius*) is recognised as a valuable source of nutrients. Lupine seeds contain significant amounts of protein, fat, minerals and dietary fibre and are increasingly used as a dietary protein source in European countries (Bartkiene *et al.*, 2016a). The dietary value of lupine proteins is higher than that of beans or peas, which is mainly due to the high concentrations of the essential amino acids (EAAs), lysine (Lys), leucine (Leu) and threonine (Thr) (Starkute *et al.*, 2016). The increase in plant protein utilisation has led to the development of new technologies, to improve plant protein bioavailability. Many factors can affect the functional properties of plant proteins. We previously investigated the biodegradation of lupine wholemeal and protein isolates/concentrates by several different lactic acid bacteria (LAB) strains and the resultant changes in lupine chemical composition Bartkiene *et al.*, 2016a). Based on the results, we hypothesised that the bioavailability of lupine seed protein could be affected by the activity of trypsin inhibitors, the free amino acids (AAs) profile, biogenic amines (BAs), antioxidant capacity of the substrate, isoflavone content and the molecular weight of new peptides formed and their properties, among others. The tryptic and peptic peptides derived from lupine protein hydrolysis were shown to modulate cholesterol metabolism (Lammi *et al.*, 2016a,b,c). Due to their health-enhancing attributes and resultant selective, effective, safe and good tolerance once consumed, plant-derived bioactive peptides are commonly consumed as part of a healthy, balanced diet and are often incorporated in functional foods, pharmaceuticals and medicines (Hayes & Bleakley, 2018). Ultimately, all changes, either or both, in the food chemical and microbial composition can influence the digestive tract microbiota, which affects the

*Correspondent: Fax: +370 37 300152;
e-mail: elena.bartkiene@lsmuni.lt

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