Improving the quality of lupine protein isolate using supercritical fluid extraction

Rubén Domínguez-Valencia[1], Mirian Pateiro[1], Roberto Bermúdez[1], Laura Purriños[1], Ricard Bou[2] and José M. Lorenzo[1,3]

[1] Centro Tecnológico de la Carne de Galicia, Spain; [2] Instituto de Investigación y Tecnología Agroalimentarias, Spain; [3] Área de Tecnoloxía dos Alimentos, Universidade de Vigo, Spain

29,30 and 31 May 2024
Higher School of Technology Agadir, Morocco
Smart Systems, Renewable Energy, Traditional Foods, and Environment Protection
ICSREFE'24 INTERNATIONAL CONFERENCE

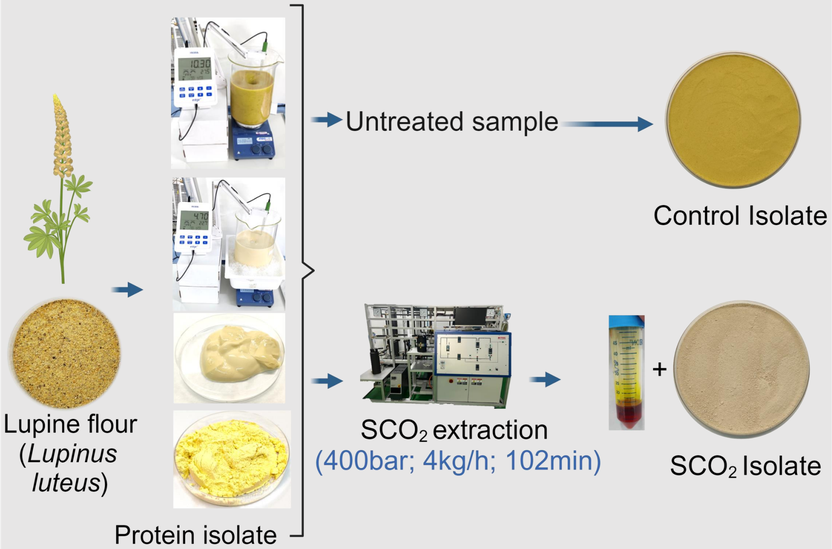
Introduction

High demand for proteins → Search for alternative sources

Lupine: Underutilized source with high protein content

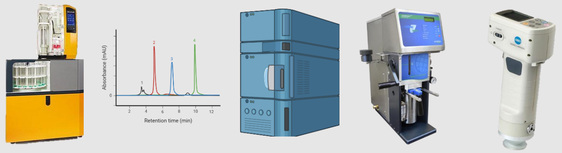
Obtaining and functionalizing high-quality lupine protein isolates

Materials & Methods



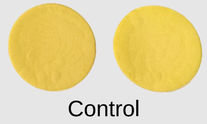
Analysis

- Oil content
- Purity (protein)
- Color
- Amino acids

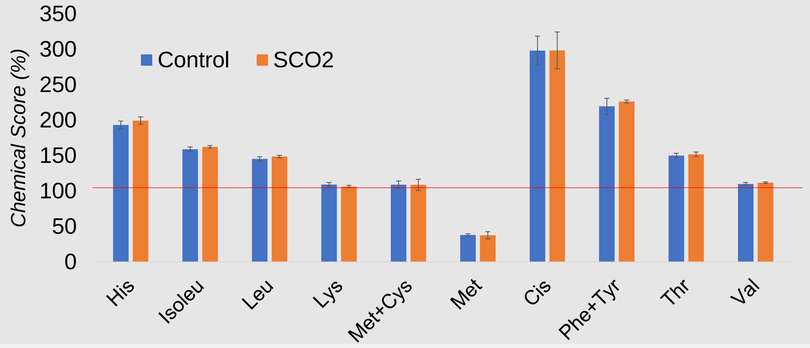


Results & Discussion

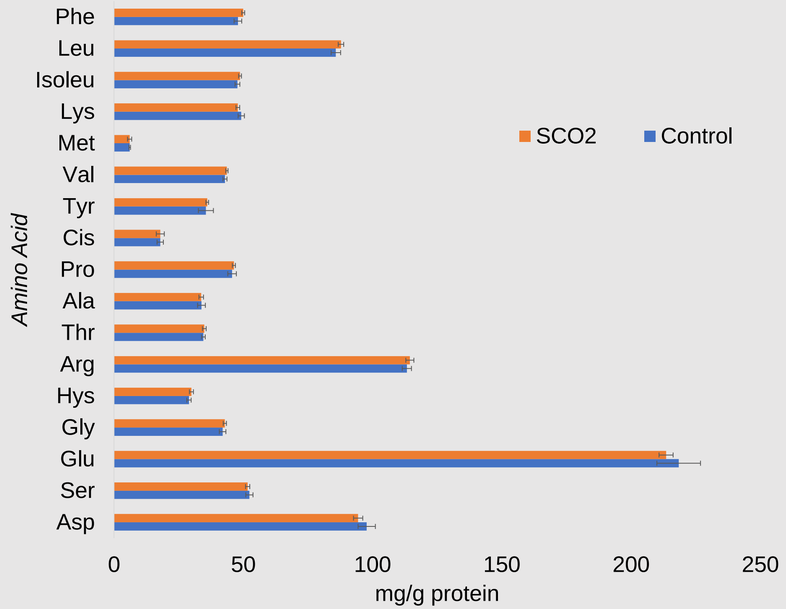
	Isolate type		SEM	Sig.
	Control	*SCO_2*		
Oil (g/100 g)	7.56±0.35	2.95±0.14	0.70	***
Protein (g/100 g)	86.3±0.25	96.0±0.59	1.48	***
Color parameters				
L*	77.4±0.24	84.6±0.64	1.09	***
a*	4.68±0.08	1.24±0.21	0.52	***
b*	45.8±0.55	22.9±0.27	3.46	***



- ✓ SCO_2 treatment decreased the oil content (61% reduction)
- ✓ SCO_2 treatment dramatically increased isolate purity (86% *vs*. 96%)
- ✓ The purity increase is due to the oil extraction during SCO_2 treatment
- ✓ SCO_2 treatment produced color changes: Yellow and red index decreased after SCO_2 treatment, while luminosity increased.
- ✓ The color changes are due to the removal of carotenoids (lipophilic compounds with an orange-reddish color) during SCO_2 treatment



- ✓ Both isolates were characterized by having high amounts of glutamic and aspartic acid, arginine, and leucine
- ✓ SCO_2 treatment did not affect the amino acid content or profile
- ✓ Treated and untreated isolates presented excellent nutritional value
- ✓ Isolates supply needs of all essential amino acids (except methionine) according to the FAO/WHO/UNU report
- ✓ The SCO_2 treatment increases the chemical score of isoleucine and leucine



Conclusion

This study demonstrates that the use of SCO_2 significantly improves the quality, color, and appearance, as well as the purity of the lupin protein isolate without affecting the amino acid composition or its nutritional properties

Topic : Traditional Foods

Acknowledgment: Grant OPFLuPAn PID2020-114422RR-C54 funded by MCIN/AEI /10.13039/501100011033

Improving the quality of lupine protein isolate using supercritical fluid extraction.

Rubén Domínguez-Valencia[1], Mirian Pateiro[1], Roberto Bermúdez[1], Laura Purriños[1], Ricard Bou[2] and José M. Lorenzo[1,3]*

[1] *Centro Tecnológico de la Carne de Galicia, Rúa Galicia Nº 4, Parque Tecnológico de Galicia, 32900 San Cibrao das Viñas, Ourense, Spain*
[2] *Instituto de Investigación y Tecnología Agroalimentarias (IRTA), Finca Camps i Armet s/n, 17121 Monells, Spain*
[3] *Área de Tecnoloxía dos Alimentos, Facultade de Ciencias, Universidade de Vigo, 32004 Ourense, Spain*

**Correspondence to: jmlorenzo@ceteca.net.*

Abstract:

The use of alternative vegetable proteins in the food industry is a current need to meet the increase in demand. Lupine is a resistant crop with high protein content, although its use as a protein source is underutilized. On the other hand, supercritical CO_2 (SCO_2) is an emerging technique for the extraction of lipid compounds, which allows the removal of oil and improves the quality of protein isolates. Thus, the objective of the present study was to verify the effect of treatment with SCO_2 on a lupin protein isolate. The protein isolate was obtained from lupin flour (*Lupinus luteus*) by basic solubilization-precipitation at the isoelectric point and finally lyophilized. One part of the isolate was kept as a control (untreated) and another was treated with SCO_2 (400 Bar, 4 kg/h, 102 min). For each type of isolate, purity (Kjeldahl method), oil content (AOAC method), color (CIELab), and amino acids (HPLC-FLD, AccQ-TAG method) were analyzed.

The oil content of the isolate (7.56%) decreased ($p<0.001$) after treatment with SCO_2 (2.95%), while the purity increased ($p<0.001$) dramatically in the SCO_2 isolate (96%) compared to the control (86.3%), mainly due to oil extraction during SCO_2 treatment. Both isolates were characterized by having high amounts of glutamic and aspartic acid, arginine, and leucine, and the treatment did not affect the amino acid content or profile (except minor changes in leucine and isoleucine content). Both, treated and untreated isolates presented excellent nutritional value, covering the supply needs of all essential amino acids (except methionine) according to the FAO/WHO/UNU report. In this case, the SCO_2 increase ($p<0.05$) the chemical score of isoleucine and leucine, which slightly increase total indispensable amino acids content.

Regarding color, treatment with SCO_2 produced significant ($p<0.001$) changes. The yellow index (b*), with values of 45.8, decreased significantly to 22.9 after SCO_2 treatment. Similarly, red index (a*) also decreased (1.24 *vs*. 4.68), while luminosity (L*) increased (84.6 *vs*. 77.4) after SCO_2 treatment. Lupine protein isolate has a characteristic color; the control isolate has an intense yellow hue, while the treated one has a light "beige" color. The color differences are because during the extraction of the oil, carotenoids (lipophilic compounds with a strong orange-reddish color) are also extracted, which eliminates a large part of the pigments of the lupine protein isolate, and determines that it has a much more neutral color (and desirable) for the food industry.

As a general conclusion, this study demonstrates that the use of SCO_2 significantly improves the quality, color, and appearance, as well as the purity of the lupin protein isolate without affecting the amino acid composition or its nutritional properties.

Grant OPFLuPAn PID2020-114422RR-C54 funded by MCIN/AEI /10.13039/501100011033.