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O1.4. Enhancing Chia Seed Protein Extraction: Impact of defatting and Optimization of Functional Properties

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Exploration and Implementation of Products with Alternative Proteins in Mediterranean Region

Transforming Protein Landscape in the Mediterranean

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Our Mission

- ProxIMed aims to revolutionize **protein consumption** in the **Mediterranean region** through **innovation** and **sustainability**.

- The project focuses on developing over **20 alternative protein products** with the active involvement of consumers, industry partners, and innovative technologies.

- By **reducing environmental impact, improving food security,** and **enhancing food choices**, ProxIMed strives to shape a **healthier and more sustainable future** for the Mediterranean population.

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Our Reach

10 Countries

17 Partners

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Our Worklist

	Alt-protein Source	Products to be Developed	Partner		Alt-protein Source	Products to be Developed	Partner
	Tomato Pomace	Fermented vegetable pickle in protein enriched solution Protein powder as an ingredient	TAT/METU		Mycoprotein	Powder as food ingredient Capsules as supplement Dessert	ANIA /UCP
	Tomato Leaf	Fermented vegetable pickle in protein enriched solution Protein powder as an ingredient	TAT/METU		Algae/Date/ Sesame cake	Dairy substitutes	UL
	Lentil	Easy mix vegan/vegetarian meatballs: A powder mix to prepare meat ball analogues Protein powder as an ingredient	HSWT/FFL		Insects	Protein powder as an ingredient Food products will be determined based on consumer studies (e.g. sport nutrition snack bars; meat and fish analogues) Animal feed	AINIA/PS/DIL
	Sesame Cake	Tahini enriched with sesame protein Protein powder as an ingredient	AUB Sonaco Al Rabih		Lentil	Protein powder as an ingredient	HSWT
	Date by-product	Protein powder as an ingredient	UoS/IRA		Chia Seed	Protein powder as an ingredient	HSWT
	Microalgae	Protein powder as an ingredient Capsules as supplement	UoS		Mallow	Protein powder as an ingredient Capsules as supplement	METU

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Why Chia: Thriving in Extreme Environments

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Drought Tolerance

Chia's roots reach deep water sources, making it well-suited for arid regions [1]

Heat Resilience

Chia can tolerate high temperatures, a valuable trait for areas experiencing heat waves [1]

Soil Health

Chia's deep roots improve soil health by increasing aeration and water infiltration, leading to greater fertility [1]

Erosion Reduction

Chia's extensive root system prevents soil erosion, protecting topsoil [1]

Crop Yield

Chia can achieve high yields in marginal lands.
Chia up to 2150 kg/ha [2]
Chickpea: 2000 kg/ha [3]
Lentils: 1200 kg/ha [4]

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Nutritional Powerhouse: The Benefits of Chia Seeds

Protein Rich

Chia seeds offer a significant protein content (18% by weight), making them a great protein source.

Fiber Champion

Chia seeds are packed with dietary fiber (34% by weight), supporting digestive health, blood sugar regulation, and satiety.

Omega-3 Power

Chia seeds are rich in omega-3 fatty acids (62-64% of their fat content), offering numerous health benefits, including reduced inflammation, heart health support, and enhanced brain function.

Complete AA Profile

Essential Amino Acid Index (EAAI): 106% Amino Acid Chemical Score (AACS): 79% Methionine identified as the limiting amino acid [5]

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Study Aim

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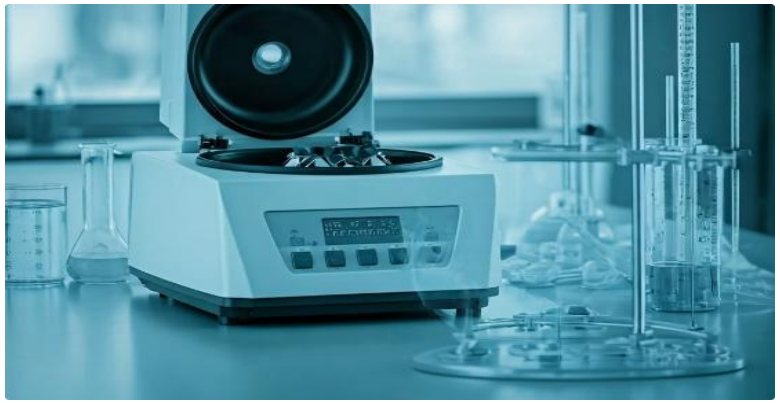

Introduction

This study explores efficient protein extraction methods from chia seeds. The primary objective is to determine the impact of different defatting techniques on protein yield and functionality.

Defatting Techniques

1. Mechanical extraction using a twin screw press
2. Supercritical fluid extraction using supercritical CO2 with ethanol as a co-solvent
3. Commercial defatting using n-Hexane as a solvent

Evaluation Metrics

- Total nitrogen content
- Protein yield
- Protein Solubility
- Water Holding Capacity
- Oil Binding Capacity
- Foam Capacity
- Foam Stability
- Emulsion Capacity
- Emulsion Stability

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Raw Material Composition: Chia Flour and Whole Seeds

Raw Material	Fat (%)	Carbohydrates (%)	Fiber (%)	Protein (%)
Organic Chia Flour (O)	6.9	4.5	44.5	28.3
Conventional Whole Chia Seeds (C)	31.4	1.6	31.9	23.2

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Defatting Methods: Exploring Chia Processing Techniques

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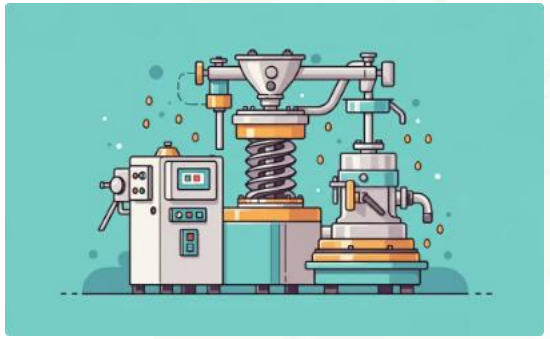
No Defatting (ND)

This method involves no defatting, leaving the ground chia seeds in their natural state, retaining their full fat content.



Mechanical Twin Screw Press (PD)

This technique uses a mechanical press to extract a portion of the fat from chia seeds, resulting in a partially defatted product.

Solvent Extraction (HEX)

This method utilizes a solvent, such as n-hexane, to remove fat from chia seeds, resulting in a product with significantly reduced fat content.

Supercritical Fluid CO2 Extraction (SCF)

This technique employs supercritical carbon dioxide, along with ethanol as a co-solvent, to extract fat from ground chia seeds, offering a more environmentally friendly alternative to traditional solvent extraction.

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Protein Extraction Process – Alkaline Solving and Isoelectric Precipitation

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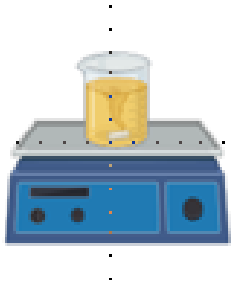
Homogenisation
3% (w/v)

Hydration
24 h @ 21 °



Heat Treatment 1
h @ 60 °C @ pH 8

Stirring
2 h @ 21 °C
@ pH 10

Centrifuge
@ 4750 RCF,
20 min @ 4 °C

Supernatant pH Adjustment
O: 3,75
C: 4

Centrifuge @
4750 RCF, 20 min
@ 4 °C

Sediment
Neutralisation 30
min @ 21 °C, pH 7

Freeze Drying

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Protein Extraction fom Chia Seeds Results

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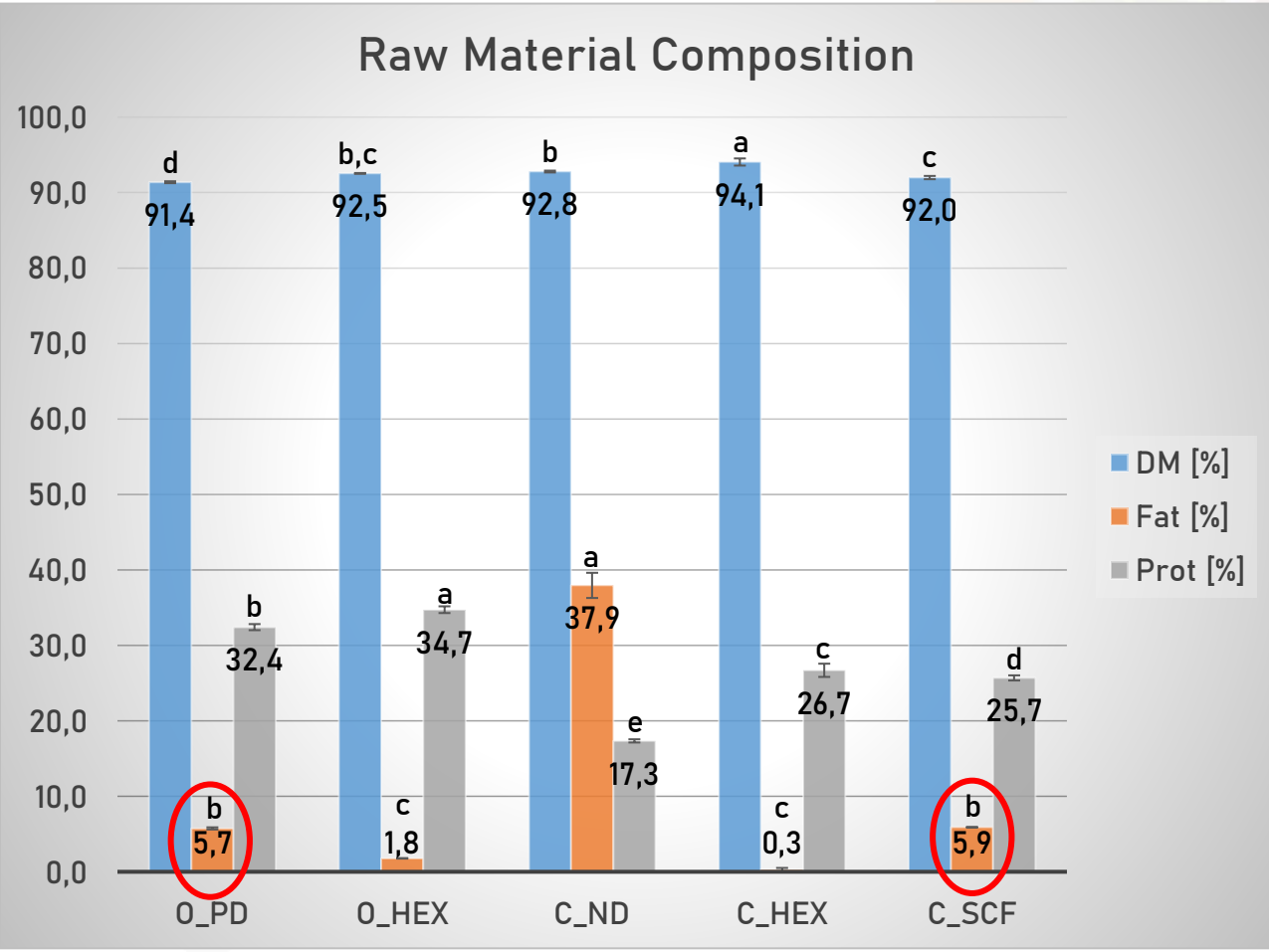

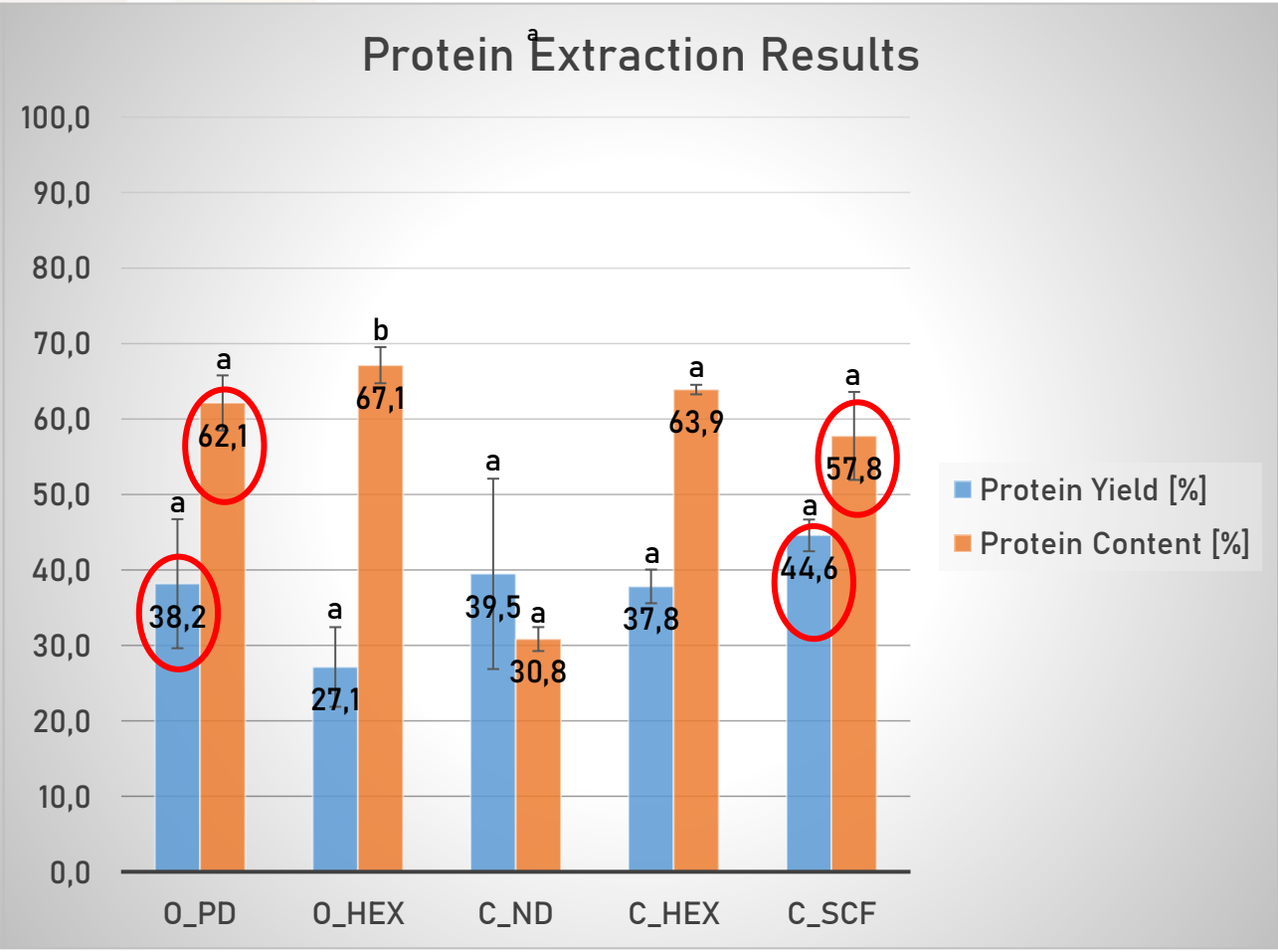

Values with the same letter indicate no significant difference at α = 0.05.

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Results Functional Properties

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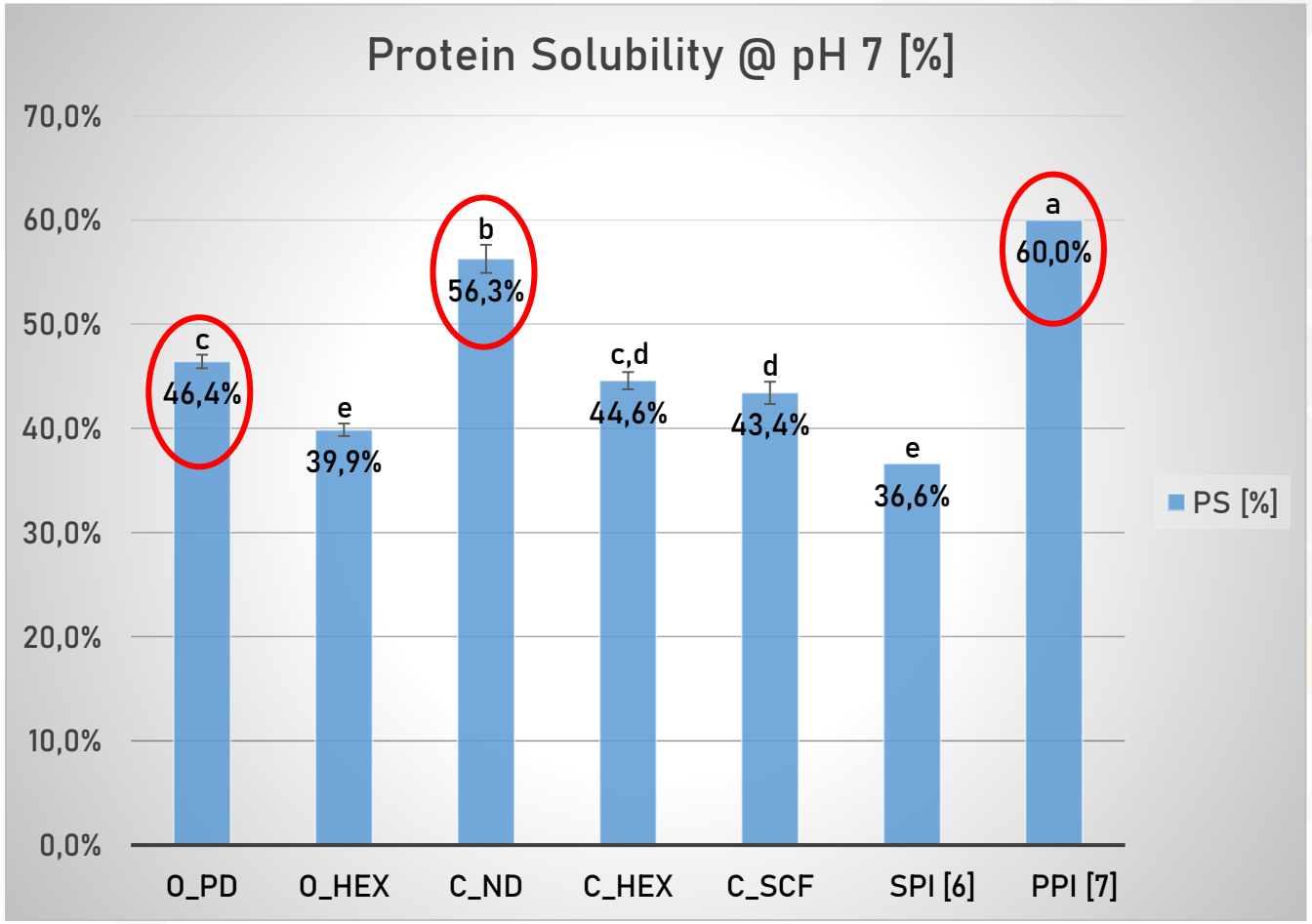

Values with the same letter indicate no significant difference at α = 0.05.

Conclusion:

1. C_ND flour highest solubility close to PPI
2. C_ND 38% protein vs PPI >80%
3. hexane and SCF defatting hints to lower solubility, changes in protein structure and increased exposure of hydrophobic regions after lipid removal [5,8,9]
5. Food Applications:
   - beverages and liquid food
   - dairy alternatives

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Results Functional Properties

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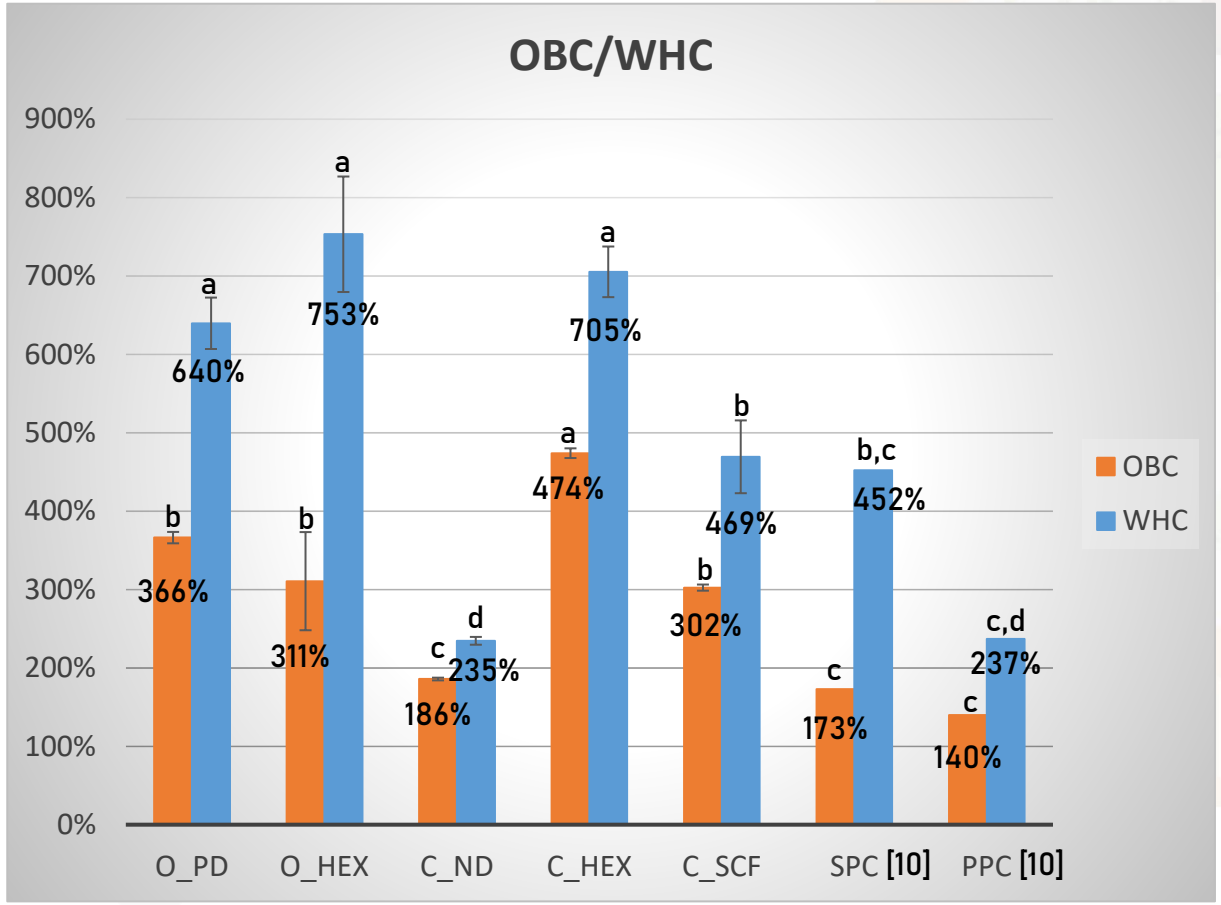

Values with the same letter indicate no significant difference at α = 0.05.

Conclusion:

1. great OBC/WBC potential for concentrates with low fat content
2. chia concentrates higher values for WHC than SPC and PPC
3. potential food applications:
   - meat alternatives
   - dairy alternatives
   - soups & sauces

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Results Functional Properties

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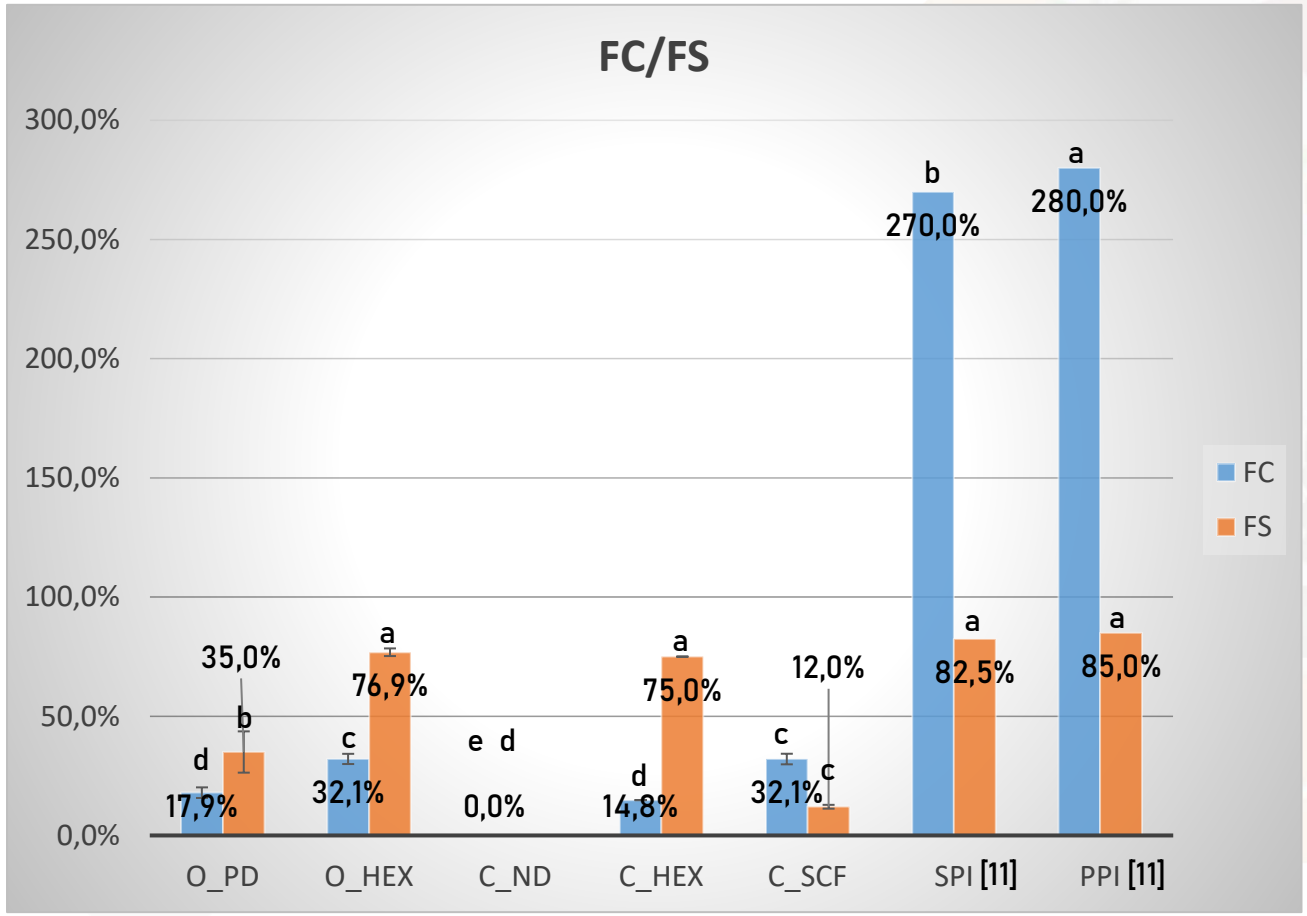

Values with the same letter indicate no significant difference at α = 0.05.

Conclusion:
1. Concentrates with lower initial fat content yield in higher FS
2. Commercial SPI, PPI provide higher potential as foaming ingredient

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Results Functional Properties

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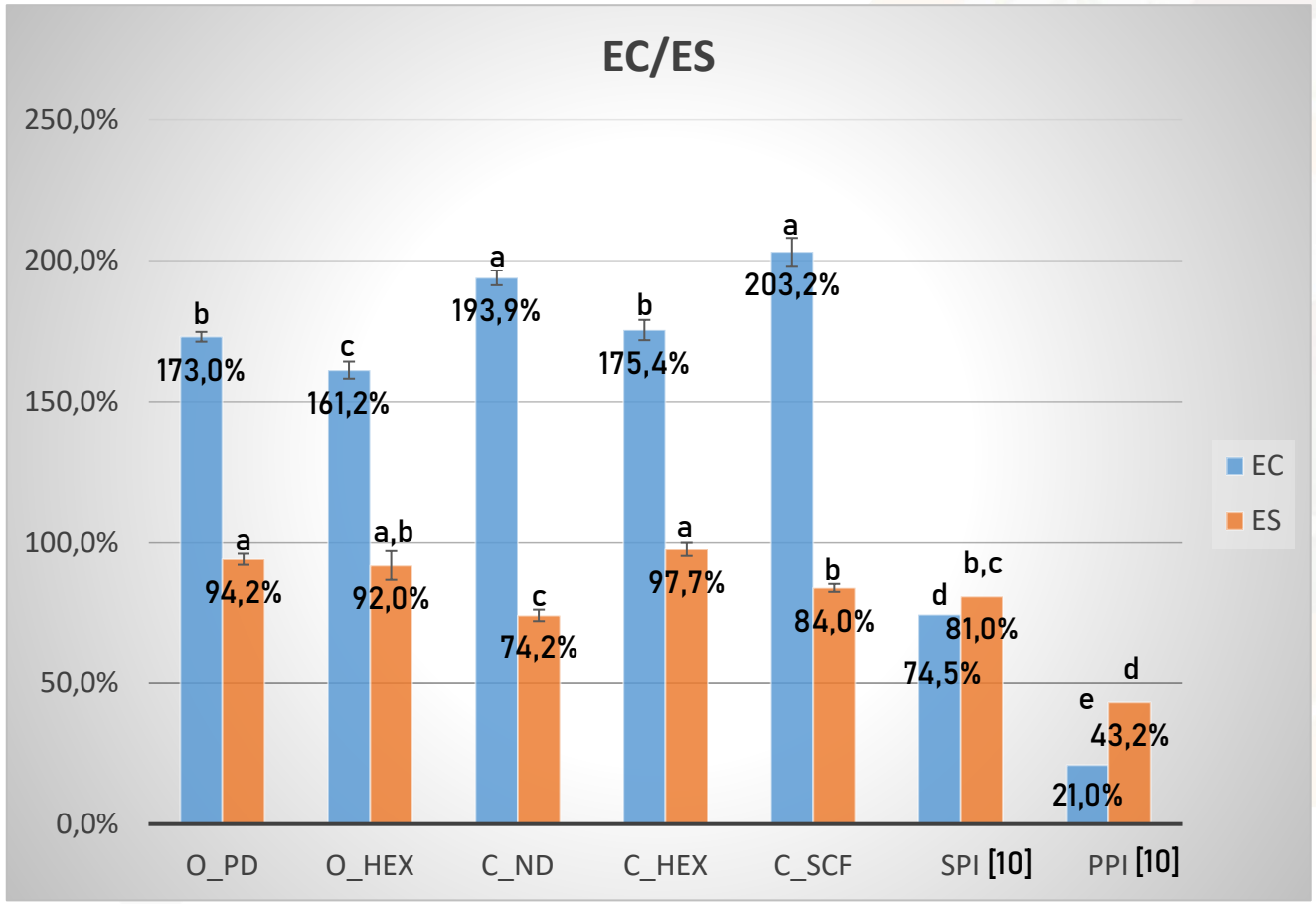

Values with the same letter indicate no significant difference at α = 0.05.

Conclusion:

1. Chia Concentrates have high potential for EC/ES
2. Food Applications:
   - Mayonaise
   - Salad Dressings
   - Ice Cream
   - Margarine
   - Meat Alternatives

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Summary and Outlook

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Summary

Partially defatted chia flour is used for further optimization-> impact on LCA

Yield shall be increased (Ultrasound, Enzymes, Ultrafiltration)

Achieve reproducible results before upscale

Chia Protein Concentrate has high potential food applications

Outlook

Digestibility

Allergenicity/Toxicity

Yield Increase (US/Enzymes)

Productdevelopment

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ODTÜ METU
Middle East Technical University

Prof. Dr. Özlem Özmutlu
M. Sc. Patricia Maag
M. Eng. Lisa Ziegltrum
M. Eng. Simon Körber

Some more insights?

Day 2. 13.11.

Room 6

Special Session 10:
Innovative Approaches to Functional Foods from Mediterranean Agricultural By-products
Chairs: Mecit Halil Öztop & Özlem Özmutlu Karslıoğlu

Prof. Dr. Mecit Halil Öztop
M. Sc. Özge Güven
M. Sc. ELİF GÖKÇEN ATEŞ

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Gramatic and spelling was corrected by Perplexity AI: https://www.perplexity.ai/

Sources

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Thank you.

I am ready for your questions.

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