**Strategies to increase the sustainability of plant-based proteins**

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This PhD project is focused on advancing the sustainability of agri-food chains in the production of plant-based proteins, compared to the existing products available on the market. The project aims to achieve this goal through a range of strategies, including the meticulous selection of raw materials, implementation of diverse agricultural practices, optimization of production processes, and valorization of generated by-products. The extraction of proteins will primarily focus on conventional alternative sources like Pea seeds.

**Strategie per aumentare la sostenibilità delle proteine di origine vegetale**

Questo progetto di dottorato si concentra sull'avanzamento della sostenibilità delle catene agroalimentari nella produzione di proteine vegetali, rispetto ai prodotti attualmente disponibili sul mercato. Il progetto mira a raggiungere questo obiettivo attraverso una serie di strategie, tra cui la meticolosa selezione delle materie prime, l'implementazione di pratiche agricole diverse, l'ottimizzazione dei processi produttivi e la valorizzazione dei sottoprodotti generati. L'estrazione delle proteine si concentrerà principalmente su fonti alternative convenzionali come i semi di pisello..

**Key words**: Plant based proteins, pea protein, extraction, functional properties.

**1. Introduction**

In accordance with the PhD thesis project previously described (ASTI,2022), this poster reports the main results of the first two activities concerning:

(A1) The characterization of different pea varieties from different production sites/years

(A2) The Application of an improved conventional extraction process (with an alkaline extraction step followed by an isoelectric precipitation step) and the investigation of the variety/site effect on extraction yield and protein functionalities.

**2. Materials and Methods**

* 1. **Characterization of raw material**

The following methods were employed to investigate various physico-chemical characteristics:

* Total dry matter content: The AOAC (1999)
* Ash content: Method 08-01 (AACC, 1984)
* Total fat content (standard Soxhlet extraction with petroleum ether after an acid hydrolysis with 4 M HCl)
* Protein content: based on the Kjeldahl method using a conversion coefficient of 6.25
* Starch content based on thepolarimetric method which determines the content of starch and high-molecular-weight starch degradation products); ~~.~~
* Total dietary fiber content (based on the AOAC Method 991.43 and AACC Methods 32-07-01)
	1. **Protein extraction protocol**

Due to confidentiality issues with the company the PhD project is carried out in collaboration with, complete details of the protocol cannot be provided. The process involved an alkaline extraction at pH 9, followed by a centrifugation step to separate a solid residue from the liquid phase. The latter was acidified to pH 4.5 to get protein precipitation. The precipitate was then separated through a further centrifugation step.

The physico-chemical characterization was also analyzed for the extracted products (Deposit, Gel, and whey).

* 1. **Statistical analysis**

a statistical analysis was performed to compare means using a 1-factor analysis of variance (ANOVA) and a Tukey test. The analysis was conducted using SPSS software. The significance level was set at a threshold of p < 0.001.

**3. Results and Discussion**

The following tables report the obtained results.

The values are reported as mean values ± standard deviations of the replicates (at least three). Content of ash, proteins, fat, starch and dietary fiber were reported on dry matter content. A Full characterization for the extraction products as well as the mass balance is still ongoing.

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| **SITE/YEAR** | **VARIETY** | **TOTAL DRY MATTER (%)** | **ASH (%)** | **TOTAL PROTEIN on DM (%)** | **TOTAL FAT on DM (%)** |
|
| **FOGGIA 2021** | A | 90,06±0,06 | 3,29±0,03 | 22,83±1,88 | 2,02±0,16 |
| B | 89,78±0,01 | 3,56±0,04 | 23,25±1,34 | 1,75±0,09 |
| C | 89,90±0,03 | 3,20±0,16 | 23,01±2,27 | 1,5±0,11 |
| D | 89,88±0,04 | 3,69±0,01 | 23,05±1,32 | 2,11±0,17 |
| **FOGGIA 2022** | A | 89,54±0,09 | 3,40±0,04 | 25,34±2,23 | 1,25±0,05 |
| B | 89,97±0,10 | 3,32±0,06 | 23,83±1,45 | 1,08±0,01 |
| C | 89,48±0,04 | 3,14±0,02 | 23,15±1,03 | 1,6±0,11 |
| D | 89,63±0,03 | 3,42±0,02 | 25,45±0,97 | 1,58±0,02 |
| **RAVENNA 2022** | A | 91,57±0,24 | 3,52±0,06 | 19,05±2,03 | 2,78±0,15 |
| B | 91,46±0,09 | 3,35±0,01 | 20,61±1,35 | 2,44±0,4 |
| C | 91,08±0,04 | 3,23±0,04 | 19,61±2,43 | 1,74±0,34 |
| D | 91,02±0,03 | 3,31±0,05 | 19,49±1,56 | 2±0,09 |
| **SCHIAVON 2022** | A | 90,38±0,09 | 3,22±0,07 | 21,82±1,84 | 2,75±0,16 |
| B | 90,33±0,12 | 3,26±0,00 | 22,23±2,57 | 2,57±0,1 |
| C | 90,97±0,10 | 3,22±0,02 | 20,83±0,83 | 2,35±0,15 |

|  |  |  |  |
| --- | --- | --- | --- |
| SITE/YEAR | VARIETY | TOTAL STARCH (%on DM) | Tota Dietary Fiber (% on DM) |
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| *FOGGIA 2021* | A | 42±0,5 | 17,72±0,52 |
| B | 42±0,5 | 18,59±0,69 |
| C | 41±0,5 | 15,22±1,49 |
| D | 40±0,5 | 18,25±1,10 |
| *FOGGIA 2022* | A | 42±0,5 | 17,31±1,21 |
| B | 37±0,5 | 19,68±0,94 |
| C | 39±0,5 | 16,75±0,48 |
| D | 41±0,5 | 17,01±0,64 |
| *RAVENNA 2022* | A | 47±0,5 | 19,54±0,68 |
| B | 42±0,5 | 21,43±0,21 |
| C | 44±0,5 | 18,80±0,16 |
| D | 43±0,5 | 19,51±0,67 |
| *SCHIAVON 2022* | A | 39±0,5 | 20,39±0,26 |
| B | 40±0,5 | 20,86±0,66 |
| C | 35±0,5 | 19,15±0,05 |

**4. References**

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