ANTI-OXIDANT ACTIVITY OF BIOACTIVE COMPONENTS FROM LEEKS

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Introduction

Large amounts of leek green leaves are discarded, contributing to food waste. This study evaluates the antioxidant activity and phenolic content of whole leeks, with emphasis on valorising the green leaves. Extracts from freeze-dried mixed leek and dried green and white parts were obtained using conventional extraction, Ultrasound-Assisted Extraction and Microwave-Assisted Extraction. Antioxidant activity was measured using the DPPH assay, and phenolic content was determined by a polyphenol quantification assay to identify a sustainable valorisation strategy.

Materials & methods

Solid-liquid extraction

Theory:

SLE is a traditional method used here as a baseline. It uses large amounts of organic solvents and acid to break cell walls and release bioactive compounds.

Methodology:

0.5 g of dried, pulverized leek was placed in a 100 mL Erlenmeyer flask with 2 mL of 6 M hydrochloric acid and topped up with solvent. The flask was heated in an oil bath on a hot plate set to 100 °C, with a Liebig condenser attached.

Solvents tested:

- Ethanol
- Ethanol/water (85:15)
- Methanol
- Methanol/water (85:15)
- Methanol/water (60:40)

Figure 1: solid extraction setup

Microwave-Assisted Extraction

***Theory*:**

MAE uses microwave energy to rapidly and uniformly heat the solvent and plant material, disrupting cell walls and releasing bioactive compounds.

***Methodology*:**

Freeze-dried mixed leek samples (5 g) were pre-soaked in 100 mL of distilled water for 30 min and then transferred to a glass vessel for MAE using an ETHOS X system with condenser cooling.

Parameters tested:

Power: 500, 700, 900 W
Time: 30, 45, 60 min

***Solvents tested*:**

water and methanol:water (80:20)

Figure 2: MAE setup

Ultrasone-Assisted Extraction

***Theory*:**

UAE is a green technique that uses ultrasonic cavitation to disrupt cell walls, enhancing the release of bioactive compounds while reducing extraction time, energy use, and thermal degradation.

***Methodology*:**

Dried leek samples were pulverized and extracted (5g in 100mL) using probe-based ultrasonication (24 kHz, 50% amplitude) for 60 minutes.

Samples tested:

- Freeze dried leek (mix)
- Vacuum dried leek (white shaft)
- Vacuum dried leek (green leaves)

Solvents tested:

- Ethanol (95%)
- Methanol:Water (80:20)
- Methanol:Water (20:80)

Figure 3: UAE setup

References

- Bernaert N. Bioactive compounds in leek (Allium ampeloprasum var. porrum): analysis as a function of the genetic diversity, harvest time and processing techniques [Internet]. 2013.
- Bioquochem. DPPH Antioxidant Capacity Assay Kit [Internet]. KF01007| DPPH Assay Kit Booklet v05. Beschikbaar op:
- Bioquochem. Polyphenol quantification assay kit [Internet]. 2021.

Results and discussion

No conclusion can be drawn about the antioxidant capacity of the bioactive component such as phenol in leeks and the amount of the bioactive component phenol in leeks.

DPPH Antioxidant Capacity Assay Kit

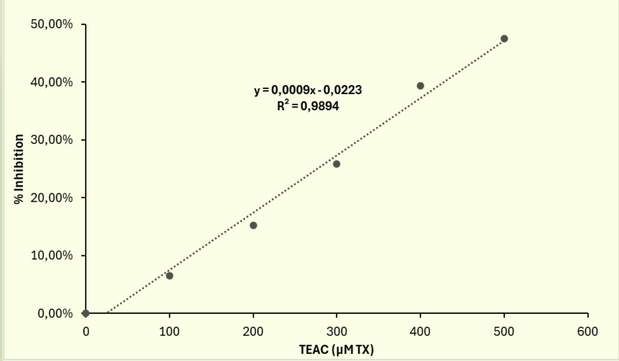

Figure 4: TX standard curve with DPPH Assay Kit

	A_1	A_2	A_{gem}	A_{corr}
S/L Ex sample 5 (100VF)	0,862	0,872	0,867	0,829
S/L Ex sample 5 (133VF)	0,869	0,861	0,865	0,827
S/L Ex 5 (500VF)	0,872	0,883	0,878	0,840
S/L Ex 5 (1*10^4VF)	0,809	0,842	0,826	0,788
UAE sample 1.1 (100VF)	0,858	0,828	0,843	0,805
UAE sample 1.1 (undiluted)	0,856	0,857	0,857	0,819
UAE sample 1:1 (undiluted, 5VF)	0,849	0,874	0,862	0,824
Blank	0,037	0,039	0,038	-

Tabel 1: measured absorbance of various unknown samples. S/L Ex sample 5 = Solid/Liquid Extraction sample 5, UAE sample 1.1 = Ultrasonic Assisted Extraction sample 1.1, DF = Dilution Factor

Polyphenol Quantification Assay Kit

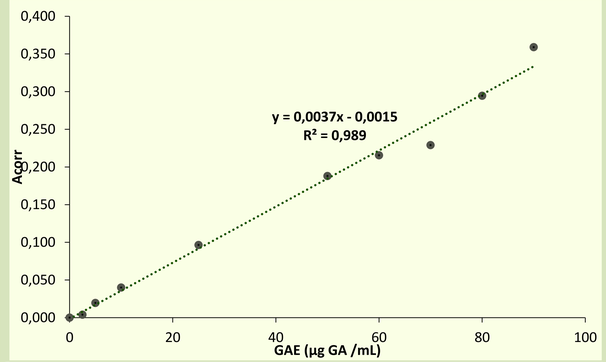

Figure 5: TX standard curve with Polyphenol Assay Kit

The phenol content in the samples cannot be determined because a white precipitate has formed after adding the sample to the test solutions. This causes a very unclear and random absorbance measurement from which no results can be obtained.

Conclusion

Solid Liquid Extraction

SLE produced the greatest and most consistent yields, up to 95% when using a methanol/water mixture (85/15). However, this process is less environmentally friendly due to its high solvent usage.

Ultrasound Assisted Extraction

UAE produced lesser yields, with the greatest results obtained utilizing ethanol and freeze-dried material. Further optimization of process parameters is required.

Microwave Assisted Extraction

The best yield was obtained with MAE at 900 W for 45 minutes, using water as the solvent. No conclusions could be drawn about antioxidant capacity.

Future Outlook

Due to analytical constraints, the bioactive quality of the extracts could not be compared. Future study should concentrate on technique optimization, solvent selection, and accurate antioxidant activity assessment.