

Ultrasound-Assisted Extraction of Bioactive Compounds from Barley

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BACKGROUND & AIM



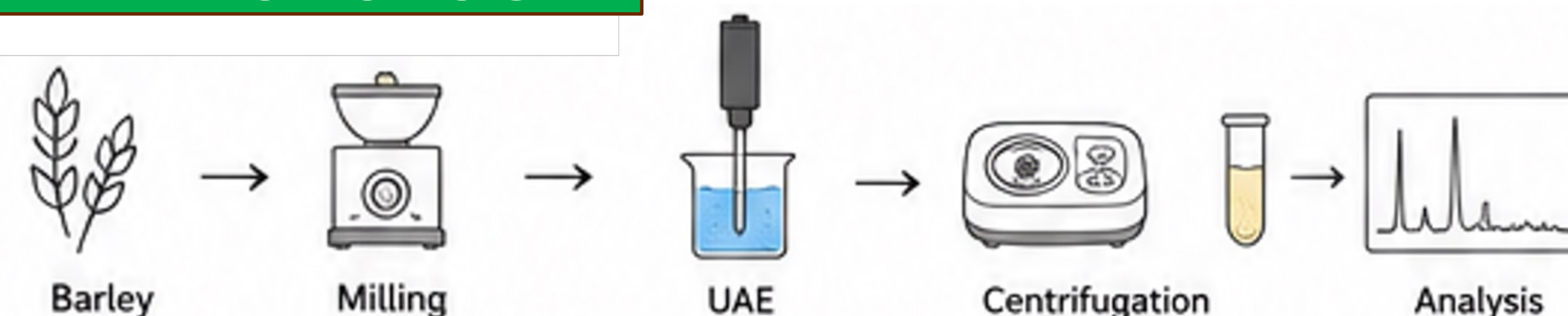
Barley (*Hordeum vulgare*) is a valuable cereal source of phenolic and other bioactive compounds.

Ultrasound-assisted extraction (UAE) can enhance mass transfer and extraction through acoustic cavitation.

Process conditions matter: Performance depends on solvent composition, ultrasound amplitude and extraction time.

Aim: to optimize UAE using RSM and characterize the resulting barley extracts.

METHODOLOGY



Experimental design

Rotatable Central Composite Design (CCD)
3 factors

- Time: 13.3-46.7 min
- Amplitude: 30-70%
- Ethanol: 25-75% (v/v)
- ~40 °C, Solid:liquid = 1:10

Response

Total Phenolic Content (TPC)

- Folin-Ciocalteu method
- Results expressed as mg gallic acid equivalents per liter of extract (mg GAE/L)

Additional analysis

HPLC Analysis

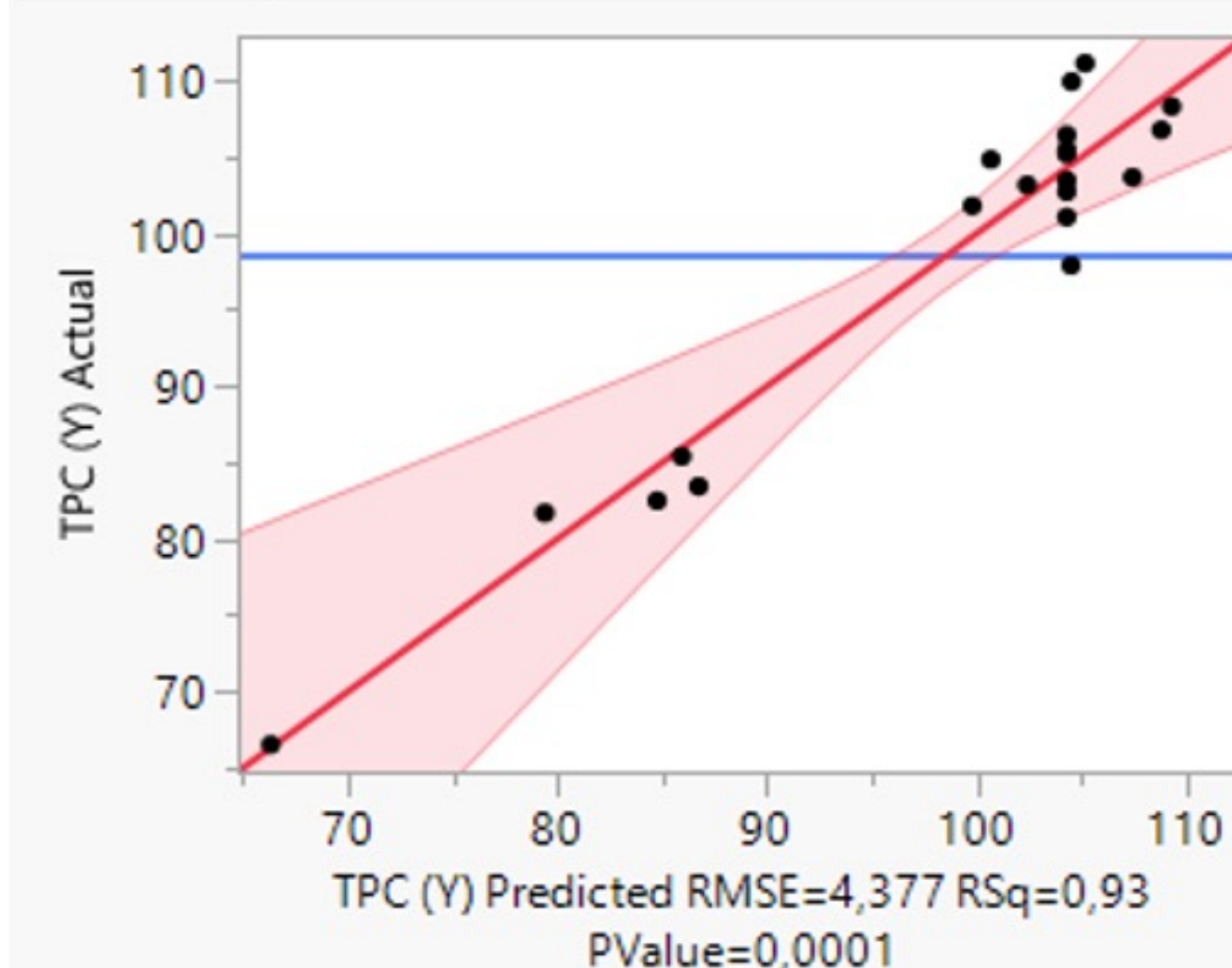
- Extract characterization and identification of phenolic acids and other compounds

RSM RESULTS

Ethanol concentration was the most influential factor for both barley materials

The models explained **93% of the variation** in TPC for dehulled barley and **89%** for whole barley.

Actual by Predicted Plot

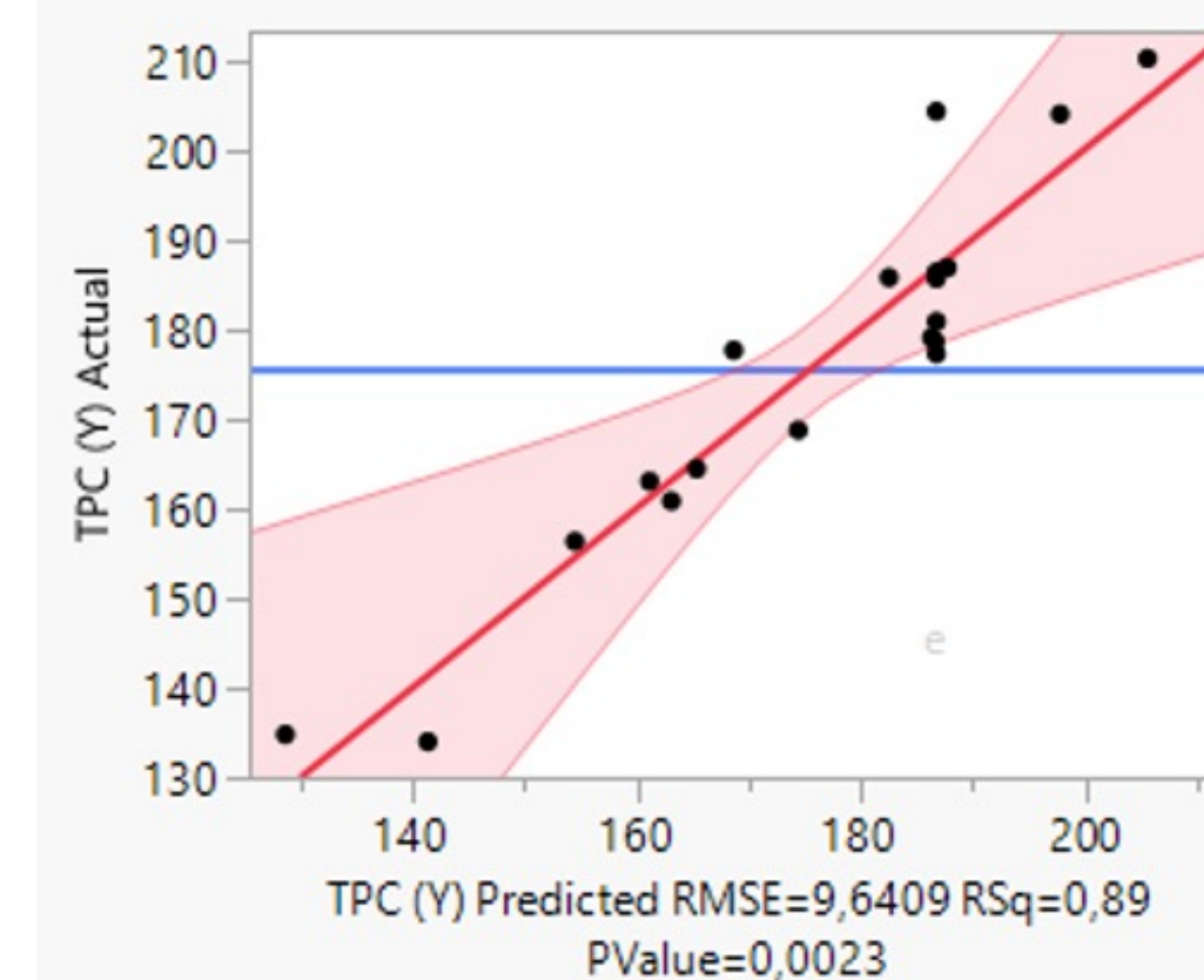


A) DEHULLED BARLEY

Effect Summary

Source	Logworth	PValue
Ethanol conc. (X3)	5,719	0,00000
Ethanol conc. (X3)*Ethanol conc. (X3)	3,710	0,00019
Time (X1)*Time (X1)	0,621	0,23919
Time (X1)*Amplitude (X2)	0,465	0,34264
Amplitude (X2)*Ethanol conc. (X3)	0,446	0,35782
Time (X1)*Ethanol conc. (X3)	0,233	0,58425
Amplitude (X2)	0,218	0,60474 ^
Amplitude (X2)*Amplitude (X2)	0,095	0,80374
Time (X1)	0,082	0,82870 ^

Actual by Predicted Plot



B) WHOLE BARLEY

Effect Summary

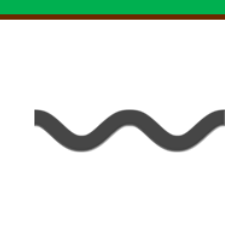
Source	Logworth	PValue
Ethanol conc. (X3)*Ethanol conc. (X3)	4,221	0,00006
Amplitude (X2)	2,222	0,00600
Ethanol conc. (X3)	0,746	0,17946
Time (X1)	0,656	0,22076
Time (X1)*Ethanol conc. (X3)	0,572	0,26793
Time (X1)*Amplitude (X2)	0,425	0,37592
Time (X1)*Time (X1)	0,311	0,48859
Amplitude (X2)*Amplitude (X2)	0,175	0,66810
Amplitude (X2)*Ethanol conc. (X3)	0,081	0,83075

OPTIMIZED CONDITIONS (WHOLE BARLEY)



Extraction time

46.7 min



Ultrasound amplitude

30%



Ethanol concentration

49.4% (v/v)

CONCLUSION

- 1 Ethanol concentration was the most influential factor affecting TPC in both barley materials.
- 2 UAE did not improve TPC recovery compared with conventional mixing under the investigated conditions.
- 3 Polar matrix components dominated the chromatographic profile, while identified phenolic acids showed low responses.

EXTRACT CHARACTERIZATION (HPLC)

