

OPTIMIZATION OF ULTRASOUND-ASSISTED EXTRACTION FOR ENHANCED CHLOROPHYLL RECOVERY AND ANTIOXIDANT ACTIVITY FROM ZUCCHINI PEEL

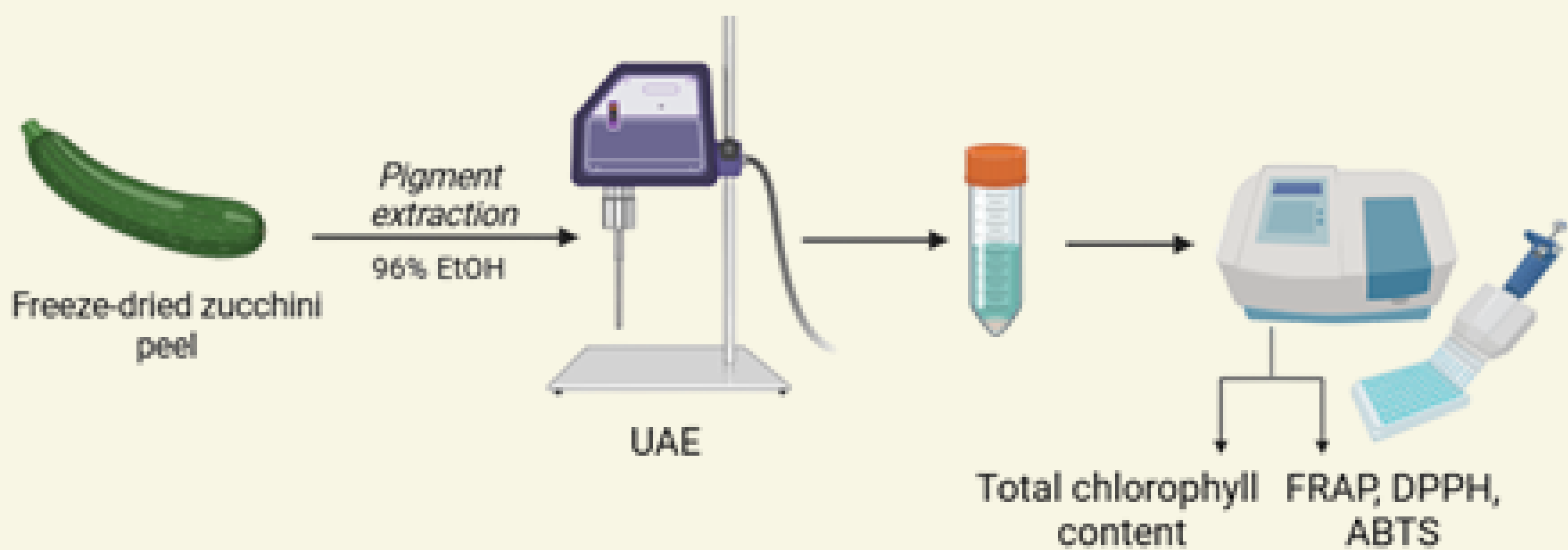
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INTRODUCTION AND STUDY AIM

Large quantities of vegetable by-products are generated during food processing, although they represent a valuable source of bioactive compounds. Chlorophylls are natural pigments with notable antioxidant properties. Therefore, the aim of this study was to optimize ultrasound-assisted extraction (UAE) of chlorophylls from zucchini peel using 96% ethanol.

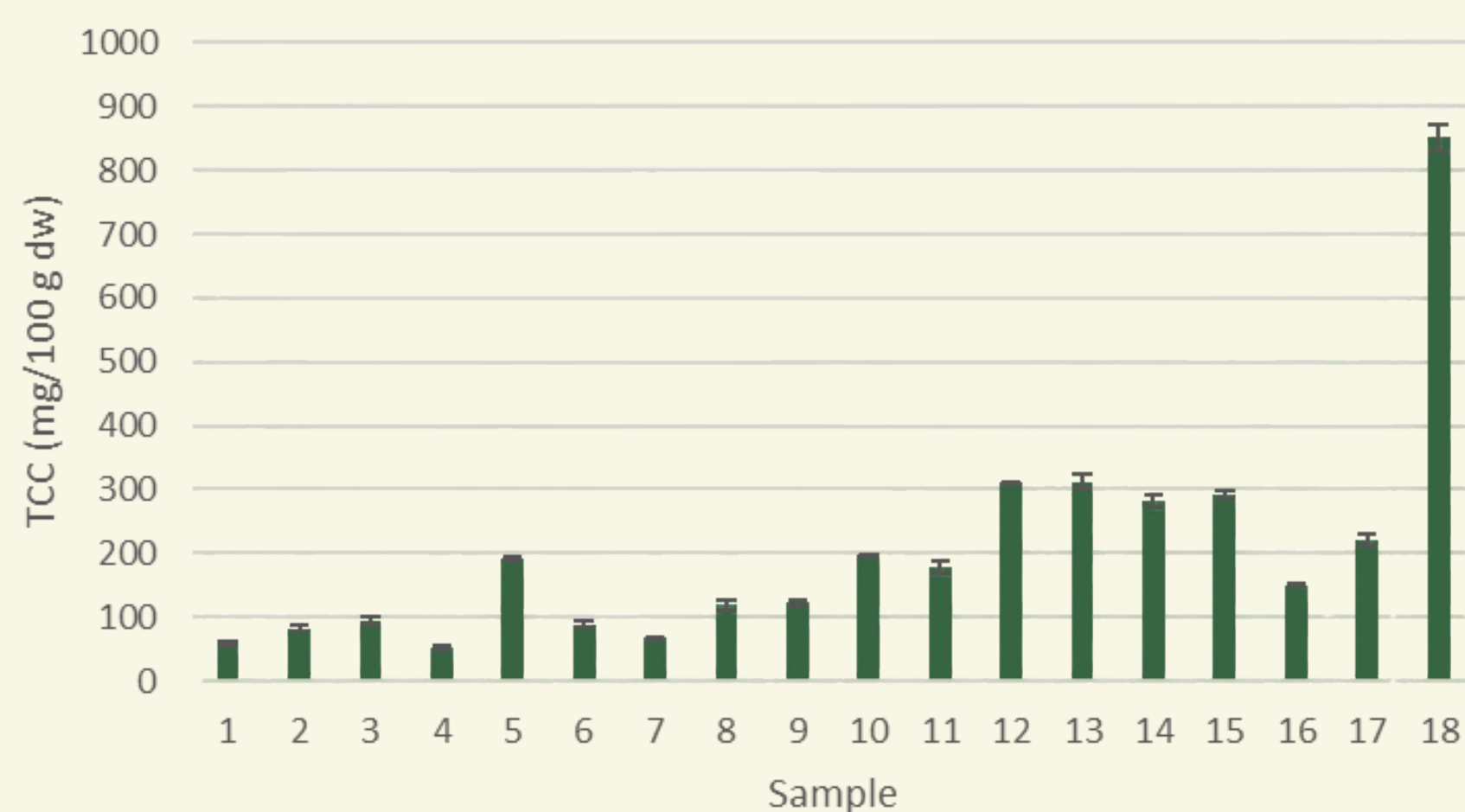
MATERIALS AND METHODS



EXPERIMENTAL DESIGN

Sample	Amplitude (%)	Time (min)	SSR (g/mL)
1	50	5	1:20
2	50	5	1:40
3	50	5	1:60
4	50	10	1:20
5	50	10	1:40
6	50	10	1:60
7	50	15	1:20
8	50	15	1:40
9	50	15	1:60
10	100	5	1:20
11	100	5	1:40
12	100	5	1:60
13	100	10	1:20
14	100	10	1:40
15	100	10	1:60
16	100	15	1:20
17	100	15	1:40
18	100	15	1:60

Figure 1. Total chlorophyll content (TCC) in zucchini peel extracts obtained under different experimental conditions.



RESULTS

- 01 Ultrasound amplitude was identified as the most influential extraction parameter.
- 02 Increasing the amplitude from 50% to 100% significantly increased TCC, FRAP and ABTS values. In contrast, DPPH values decreased (Table 1).
- 03 Extraction time (5–15 min) had no significant effect on any of the analyzed responses, despite a numerical increase in all measured parameters.
- 04 The solid-to-solvent ratio (SSR) significantly affected antioxidant capacity (by ABTS and DPPH).

Table 1. Effects of UAE parameters (amplitude, extraction time, and SSR) on TPC and antioxidant capacity (FRAP, ABTS, and DPPH).

	TCC (mg/100 g d.w.)	FRAP (μmol /100 g d.w.)	ABTS (μmol /100 g d.w.)	DPPH (μmol /100 g d.w.)
amplitude (%)	p < 0.001*	p < 0.001*	p = 0.019 *	p = 0.002 *
50	97.40 ± 9.82a	475.22 ± 44.00a	324.62 ± 26.32a	438.83 ± 39.12b
100	310.75 ± 48.35b	1539.86 ± 196.67b	500.79 ± 57.20b	250.98 ± 30.23a
time (min)	p = 0.643	p = 0.533	p = 0.784	p = 0.752
5	153.69 ± 26.04a	757.26 ± 161.96a	382.69 ± 39.04a	323.44 ± 47.98a
10	203.10 ± 30.73a	1002.02 ± 170.11a	404.29 ± 39.25a	343.99 ± 45.41a
15	255.42 ± 81.57a	1236.34 ± 329.34a	451.14 ± 89.55a	367.29 ± 60.18a
SSR	p = 0.160	p = 0.210	p < 0.001*	p < 0.001*
1:20	139.57 ± 28.28a	706.01 ± 139.58a	245.71 ± 21.19a	206.45 ± 12.50a
1:40	179.34 ± 19.70a	863.41 ± 109.84a	399.57 ± 17.54b	328.76 ± 39.68a
1:60	293.30 ± 80.00a	1426.20 ± 341.26a	592.84 ± 71.05b	499.51 ± 49.02b

*statistically significant factor. Values within the cells marked with different letters are statistically significant at p≤0.05. Results are expressed as mean ± standard error.

CONCLUSIONS

Overall, ultrasound amplitude was the key factor for maximizing chlorophyll recovery and antioxidant capacity, while a higher SSR enhanced radical scavenging activity. These findings demonstrate the potential of zucchini peel as a sustainable source of chlorophyll rich extracts with antioxidant properties



Protect Nature



Conserve Resources



Sustainable Future

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