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**Effect of high voltage electric discharge on the extraction of phenolic compounds from mandarin (*Citrus unishu* M. var. *okitsu*) peel waste**

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# Citrus peel

- Industrial citrus processing- large quantities of by-products (mainly citrus peel)
- High amount of bioactive compounds
- Hesperidin-main compound



# Experimental work

## High Voltage Electric Discharge (HVED) assisted extraction procedure

- Different experimental conditions:
- solvent:solid ratio (200, 300, 400 mL/g),
- frequency (40, 70, 100 Hz)
- treatment time (5, 10, 15 min),

Custom-built equipment constructed by Ingeniare CPTS1





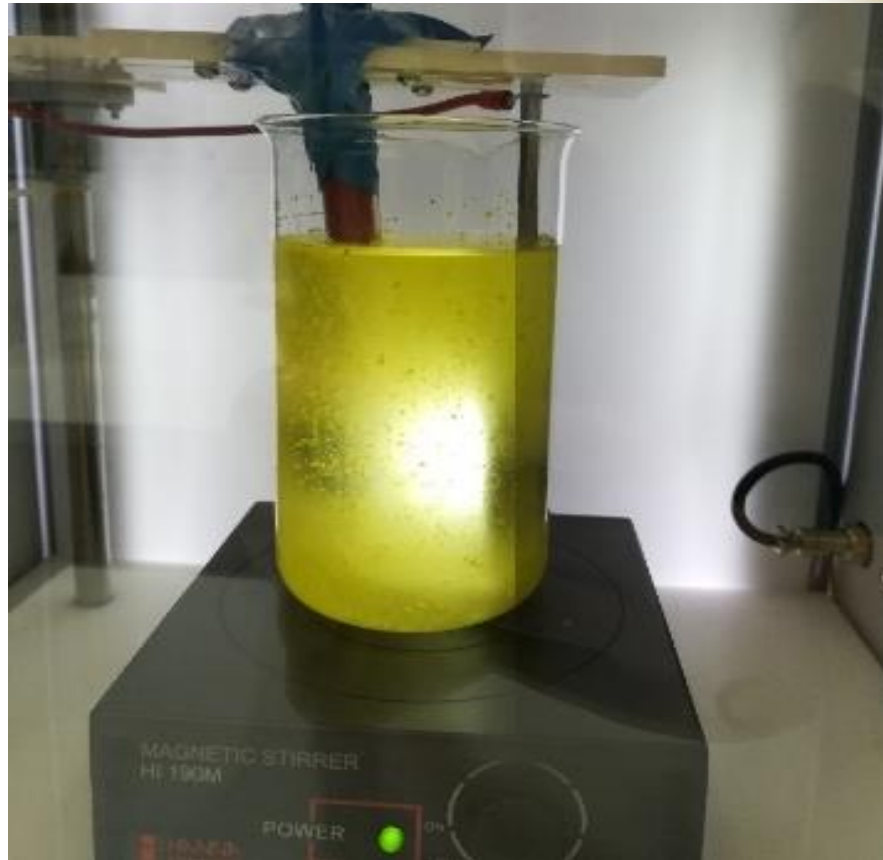
# Experimental work

## Analysis

- Separation, identification and quantification of phenolic compounds -HPLC with a variable wavelength detector.



# RESULTS



**Figure 1. Formation of an electrical discharge between two electrodes in citrus peel extract during HVED treatment**

# RESULTS

Table 1 Extraction yield, total phenol content and antiradical activity for citrus peel extracts obtained with HVED

|    | Total phenol content (mg GAE/g) | DPPH (%) | Extraction yield (mg/g) |
|----|---------------------------------|----------|-------------------------|
| 1  | 134.44                          | 92.22    | 416.80                  |
| 2  | 166.23                          | 91.97    | 430.00                  |
| 3  | 176.49                          | 94.93    | 389.00                  |
| 4  | 173.15                          | 92.68    | 453.00                  |
| 5  | 179.31                          | 92.30    | 432.00                  |
| 6  | 170.59                          | 92.09    | 427.20                  |
| 7  | 275.46                          | 92.85    | 391.50                  |
| 8  | 274.18                          | 91.80    | 426.10                  |
| 9  | 176.23                          | 92.50    | 432.31                  |
| 10 | 161.36                          | 90.99    | 424.80                  |
| 11 | 96.23                           | 93.91    | 441.20                  |
| 12 | 270.85                          | 91.75    | 359.50                  |
| 13 | 138.28                          | 92.30    | 418.40                  |
| 14 | 115.21                          | 87.06    | 456.00                  |
| 15 | 193.92                          | 91.97    | 463.20                  |
| 16 | 204.95                          | 92.18    | 422.40                  |
| 17 | 232.13                          | 92.90    | 424.01                  |

# RESULTS

Table 2 Phenolic compounds detected in citrus peel extracts obtained with HVED

| RUN | Hesperidin (mg/g) | Narirutin (mg/g) | Rutin (mg/g) | Cryptochlorogenic acid (mg/g) | Neochlorogenic acid (mg/g) |
|-----|-------------------|------------------|--------------|-------------------------------|----------------------------|
| 1   | 58.51             | 12.77            | 2.49         | 1.05                          | 0.68                       |
| 2   | 59.96             | 13.55            | 2.25         | 0.98                          | 0.68                       |
| 3   | 64.74             | 13.72            | 4.35         | 0.75                          | 0.53                       |
| 4   | 59.46             | 13.95            | 4.33         | 0.93                          | 0.72                       |
| 5   | 67.07             | 14.20            | 4.62         | 0.79                          | 0.64                       |
| 6   | 70.62             | 14.53            | 2.55         | 0.81                          | 0.64                       |
| 7   | 69.76             | 14.74            | 2.66         | 0.84                          | 0.60                       |
| 8   | 55.88             | 7.47             | 1.37         | 0.43                          | 0.33                       |
| 9   | 59.16             | 12.87            | 4.19         | 0.39                          | 0.54                       |
| 10  | 67.08             | 14.67            | 4.78         | 0.85                          | 0.68                       |
| 11  | 59.22             | 17.39            | 5.10         | 1.10                          | 1.10                       |
| 12  | 72.91             | 12.19            | 5.25         | 0.86                          | 0.66                       |
| 13  | 50.52             | 13.51            | 4.00         | 0.85                          | 0.62                       |
| 14  | 62.90             | 14.40            | 5.05         | 0.76                          | 0.72                       |
| 15  | 58.71             | 13.76            | 4.56         | 0.69                          | 0.71                       |
| 16  | 64.50             | 14.54            | 4.92         | 0.65                          | 0.68                       |
| 17  | 68.32             | 14.58            | 5.13         | 0.67                          | 0.61                       |





# CONCLUSION



- HVED treatment - enhanced extraction efficiency
- Intensified mass transfer and increased release of intracellular compounds into the solvent
- Citrus-peel material rich in bioactive compounds

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Application of innovative techniques of the extraction of bioactive components from by-products of plant origin

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