

Does Pulsed Electric Field (PEF) treatment of avocado increase cold pressed oil yield?

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Introduction



- Pulsed Electric Field (PEF) treatment uses short, high voltage pulses to induce pores in the cell membrane increasing cell leakage
- Previously reported to increase cold pressed *olive* oil yield by $\approx 10\%$.
- PEF has potential to increase the yield of cold pressed avocado oil (CPAO) from the avocado flesh
- Oil extraction from avocado is currently carried out on ripe fruit but extraction from unripe fruit could be a significant commercial advantage

Aim



- This project aimed to determine whether Pulsed Electric Field (PEF) treatment of 'Hass' avocados:
 1. Increased avocado oil yield in ripe fruit (standard commercial process)
 2. Increased oil availability and improved handling of unripe fruit during processing



Methods

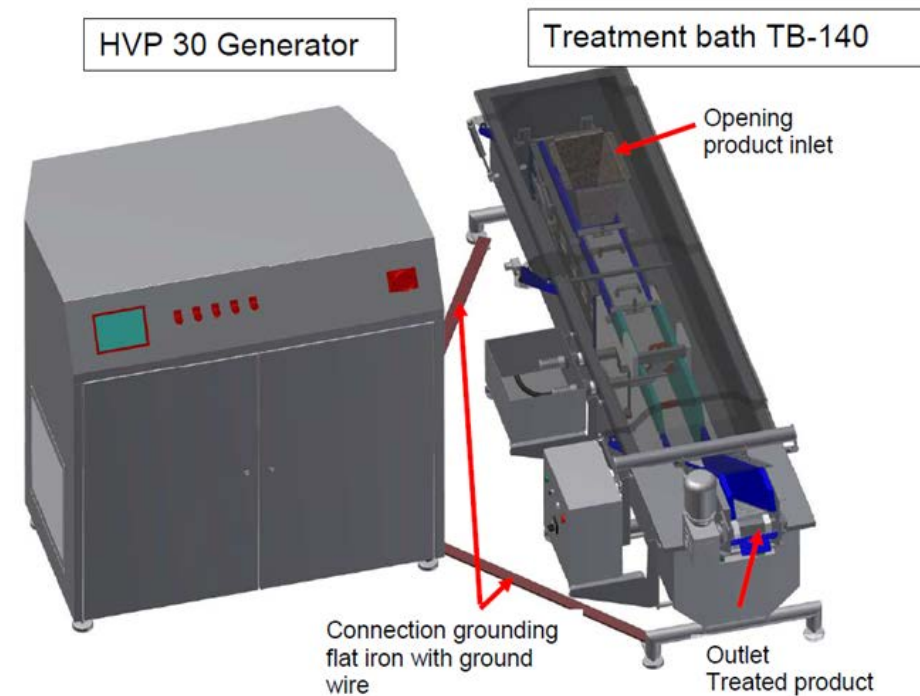


- Fruit harvested in October from Waiau Pa, New Zealand (DM = 27.5%)
- 2x firmness treatments (ripe and unripe)
- 2x PEF Treatments
 - Untreated controls (8 fruit, 3x replicates, 2x firmness)
 - PEF treated fruit (8 fruit, 3x replicates, 2x firmness)

- PEF settings:

Model: Elea HVP30 generator and TB-140 treatment bath

- Conveyor speed 1.5
- Output voltage 85%
- Frequency 250 Hz
- Charging power ~25,500
- Water conductivity 800-1,200 μ s/cm



Methods (continued)



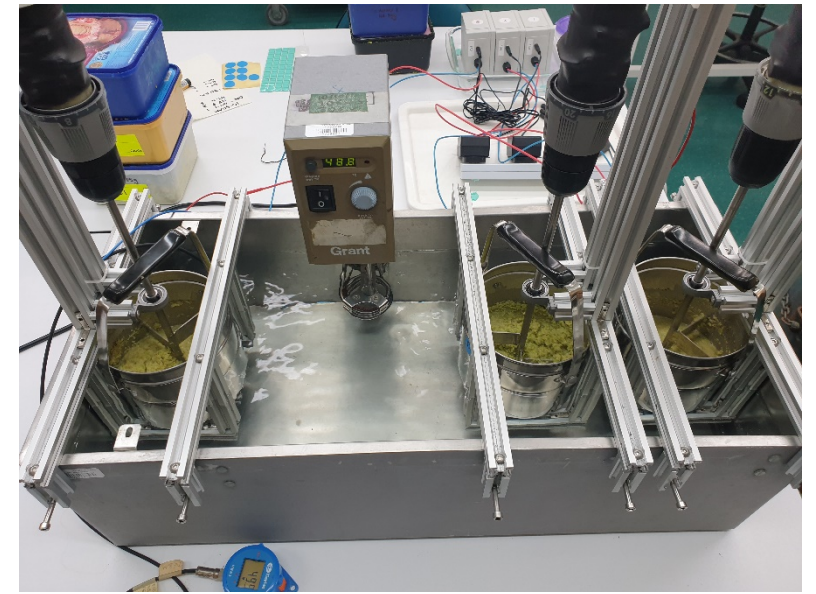
- Firmness was measured before and after treatment
- Temperature was monitored before and after treatment, as well as throughout processing
- Processing:



Cut



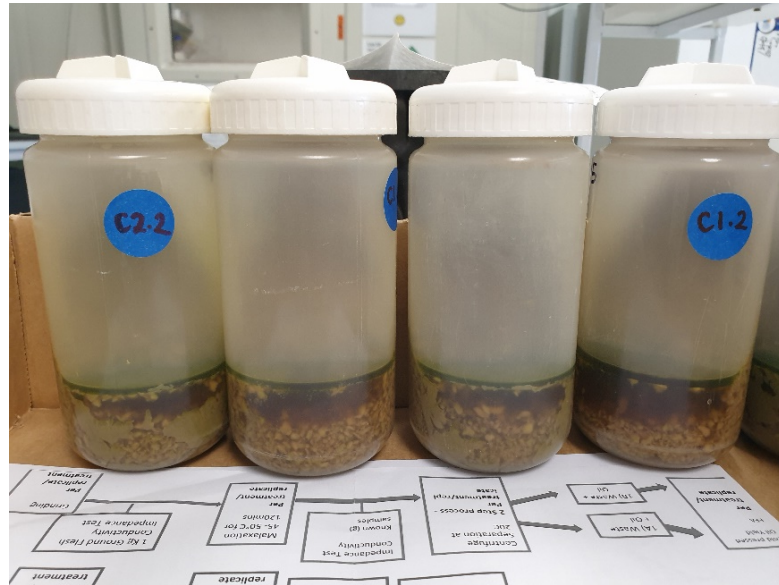
Ground



Malaxed



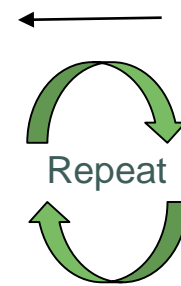
Oil



Pipetted



Centrifuged



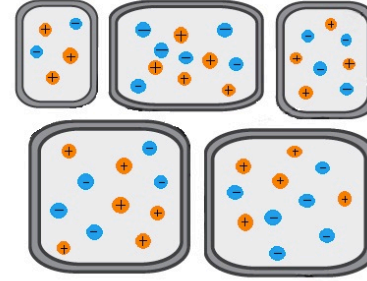
Methods (continued)

- **Electrolyte leakage**

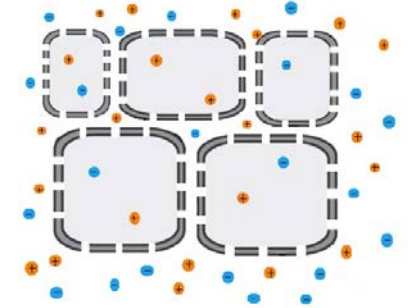
- Tissue incubated in mannitol solution – telling us about the “leakiness” of the tissue

- **Impedance (resistance)**

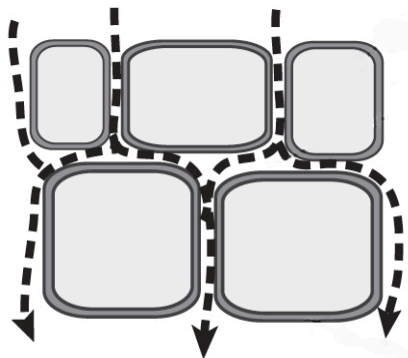
- An electrical current used to measure the resistance between the two probes, where any cellular disruption results in a reduction in resistance



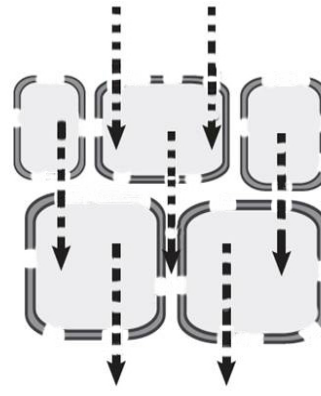
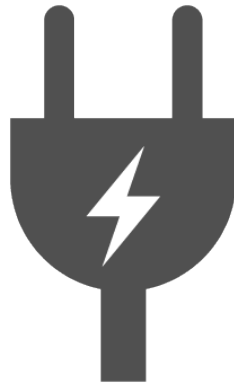
Lower conductivity



Higher conductivity



Higher resistance



Lower resistance

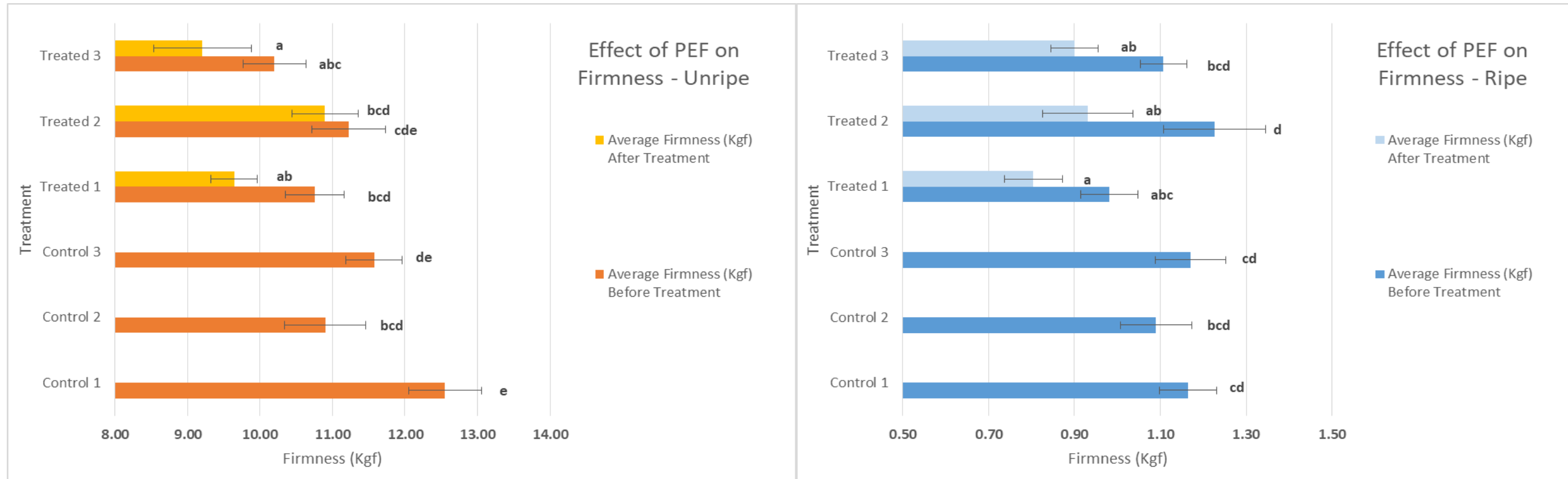


Results: Effect of PEF on avocado firmness after treatment



Unripe

Ripe

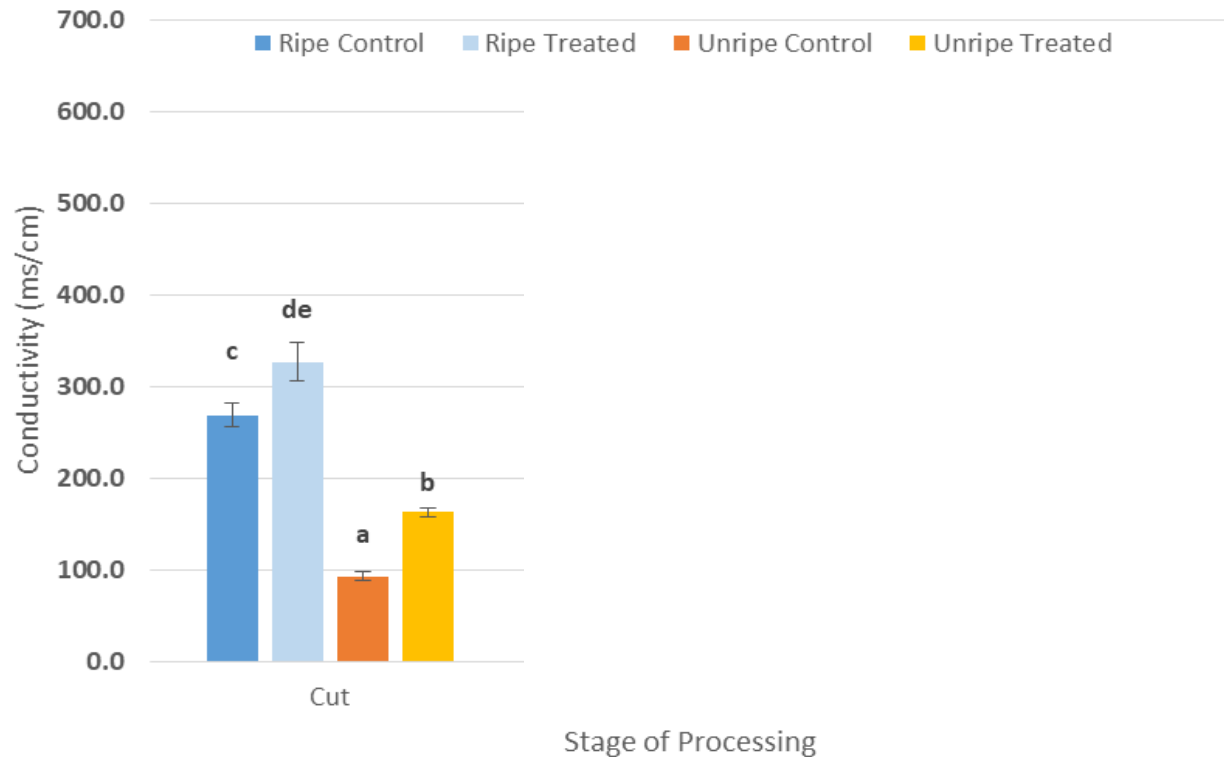


- » PEF treatment of unripe and ripe fruit led to a decrease in firmness.
- » However, these decreases in firmness were found not to be significant in most instances.

Effect of PEF on avocado cell integrity - Conductivity



Effect of PEF on Electrolyte Leakage

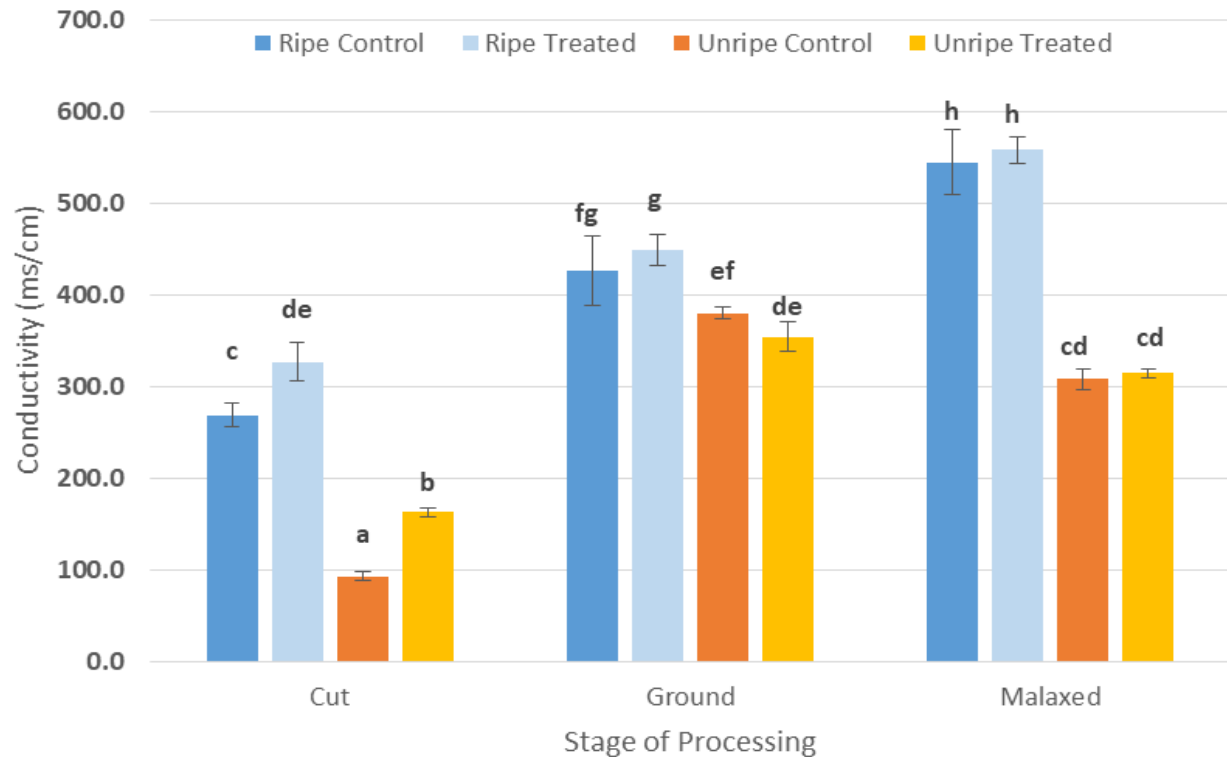


- PEF increased conductivity/electrolyte leakage of cells for cut fruit in both ripe and unripe fruit.
- Indicates increased membrane leakage

Effect of PEF on avocado cell integrity - Conductivity



Effect of PEF on Electrolyte Leakage

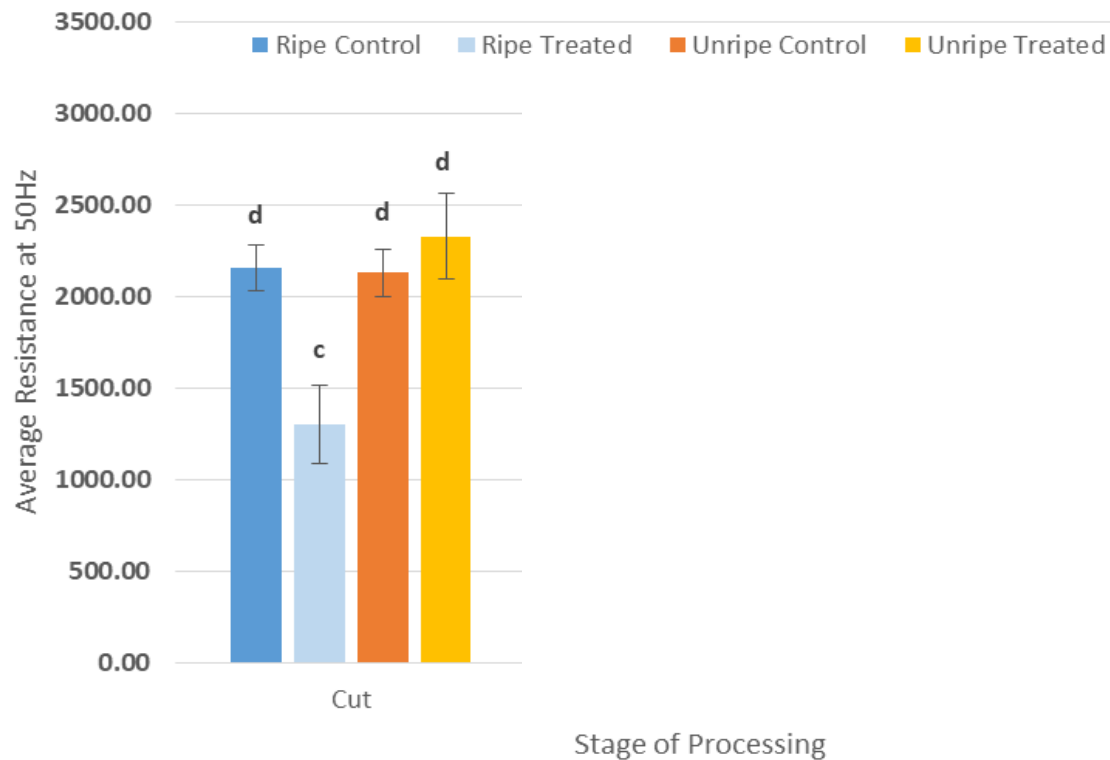


- PEF increased conductivity/electrolyte leakage of cells for cut fruit in both ripe and unripe fruit.
- Indicates increased membrane leakage
- Conductivity increased throughout the processing steps: Cut<Ground<Malaxed.
- No significant effect from PEF at later processing steps

Effect of PEF on avocado cell integrity - Impedance

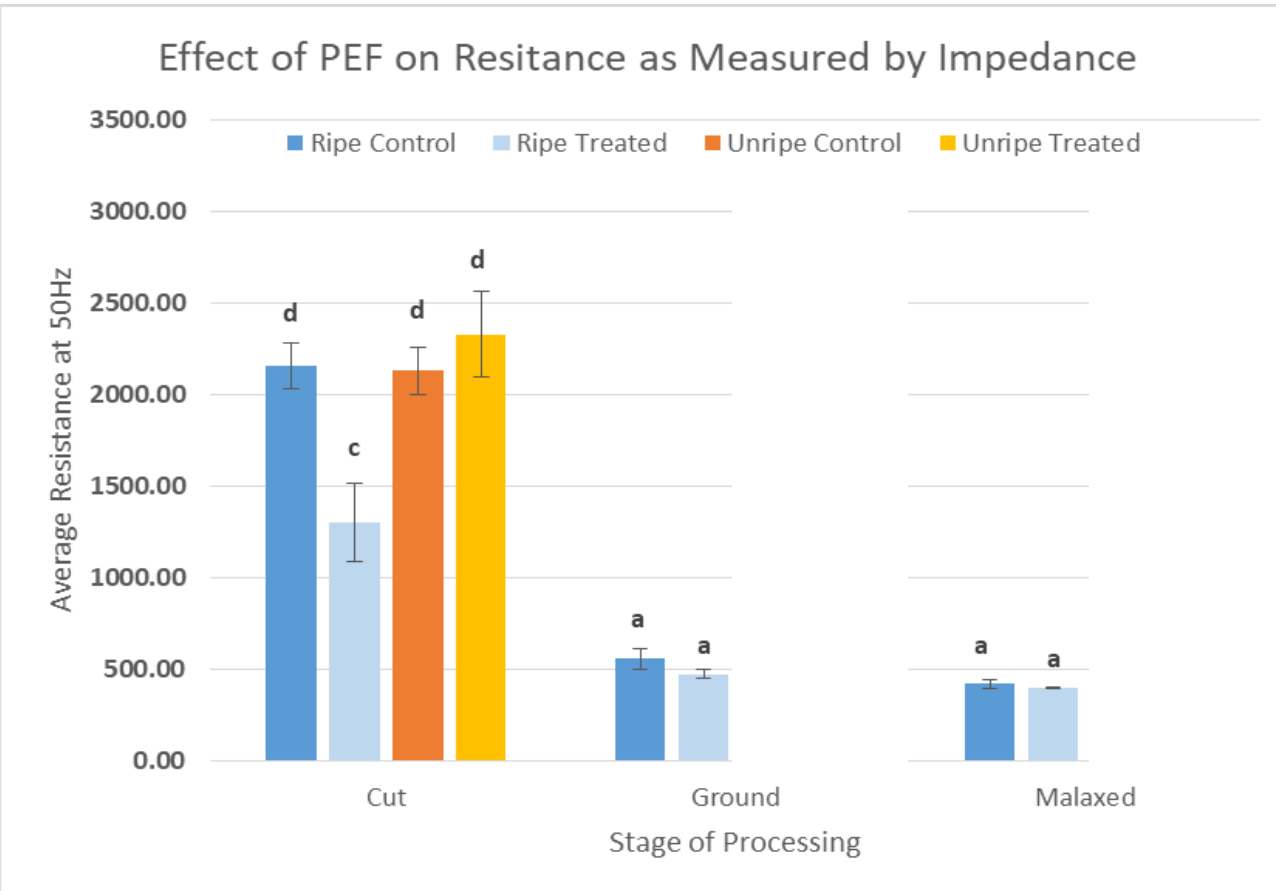


Effect of PEF on Resistance as Measured by Impedance



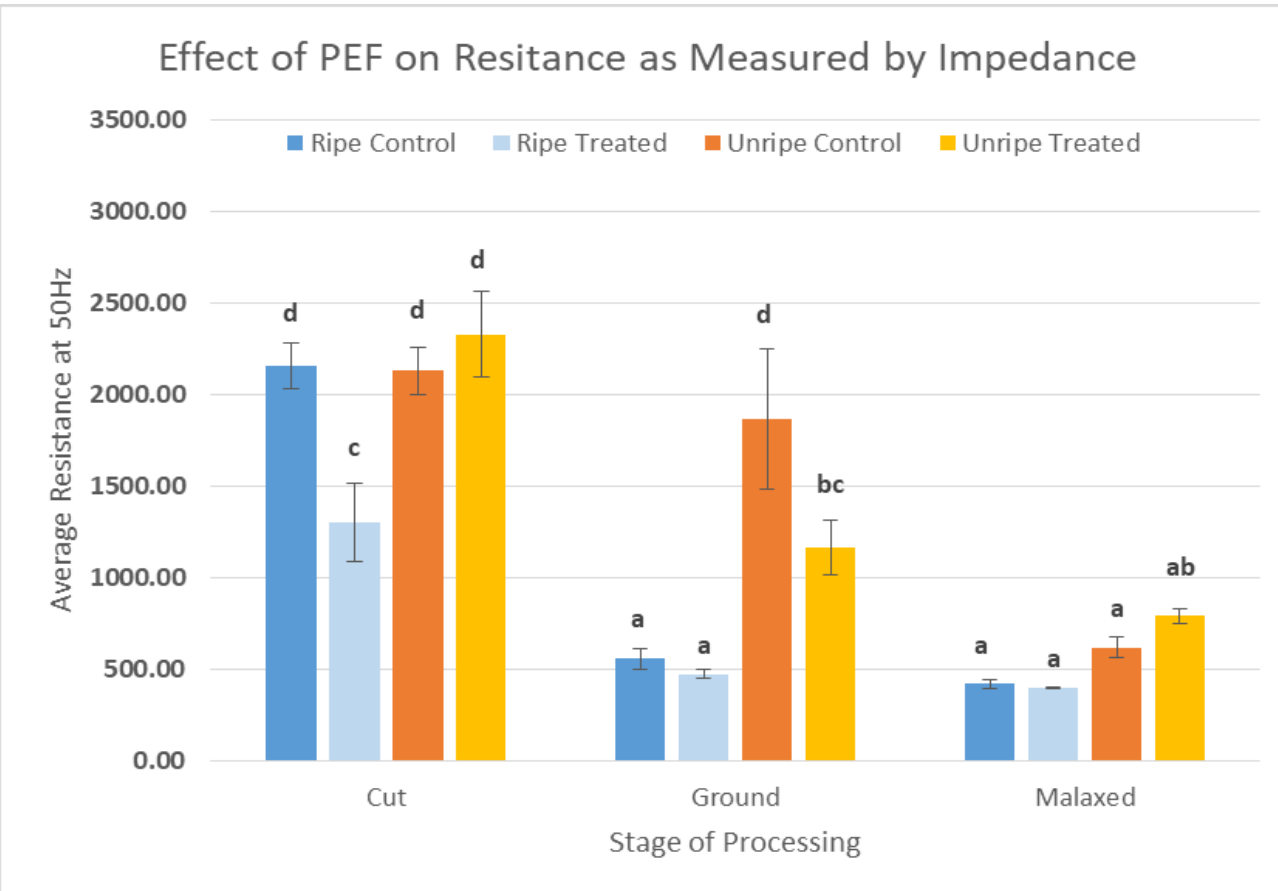
- Large variability, likely due to varying firmness and DM.
- PEF significantly decreased resistance in cut ripe fruit
- PEF treatment of unripe fruit resulted in no significant differences in resistance at the cut stage.

Effect of PEF on avocado cell integrity - Impedance



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- In ground/malaxed tissue there were no significant differences between treated and untreated controls for ripe fruit.

Effect of PEF on avocado cell integrity - Impedance

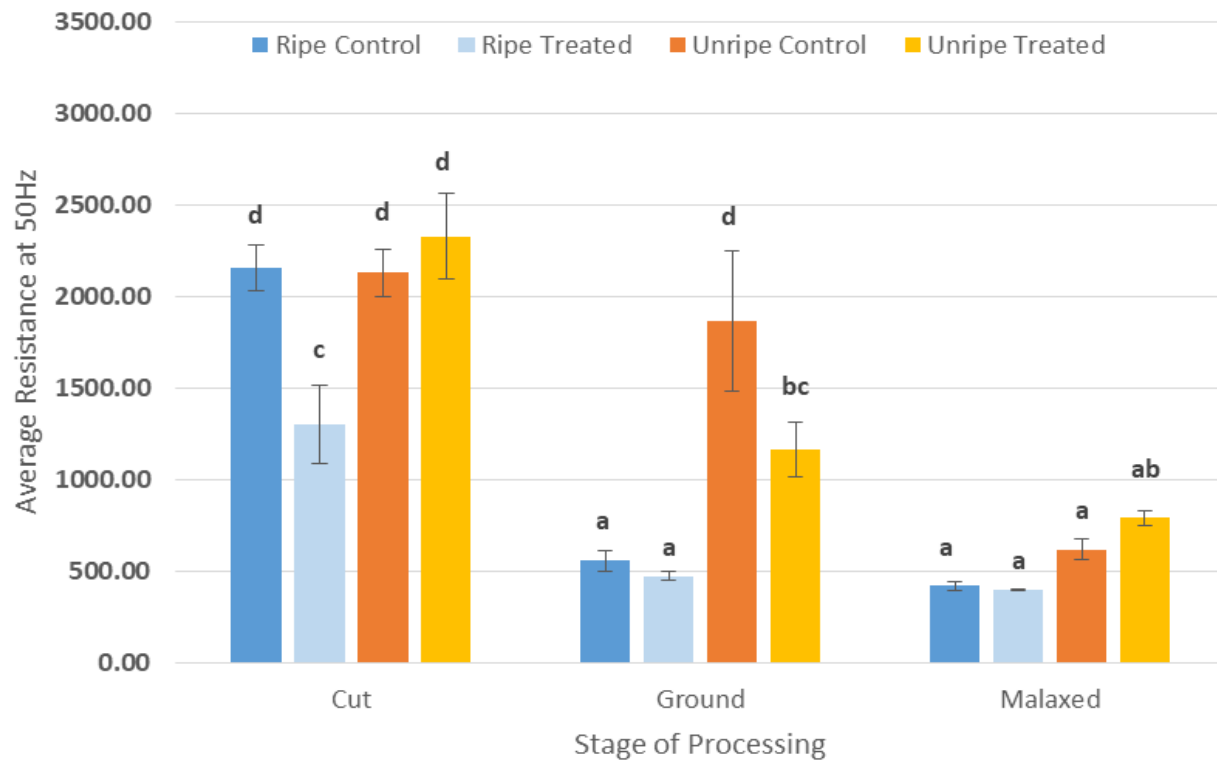


- Large variability, likely due to varying firmness and DM.
- PEF significantly decreased resistance in cut ripe fruit
- PEF treatment of unripe fruit resulted in no significant differences in resistance at the cut stage.
- In ground/malaxed tissue there were no significant differences between treated and untreated controls for ripe fruit.
- Impedance unlikely to be a good measure of unripe fruit at the ground/malaxed stages, as fruit were not in a liquid state and water was required to be added during malaxing to allow stirring.

Effect of PEF on avocado cell integrity - Impedance



Effect of PEF on Resistance as Measured by Impedance



Ripe, ground



Unripe, ground



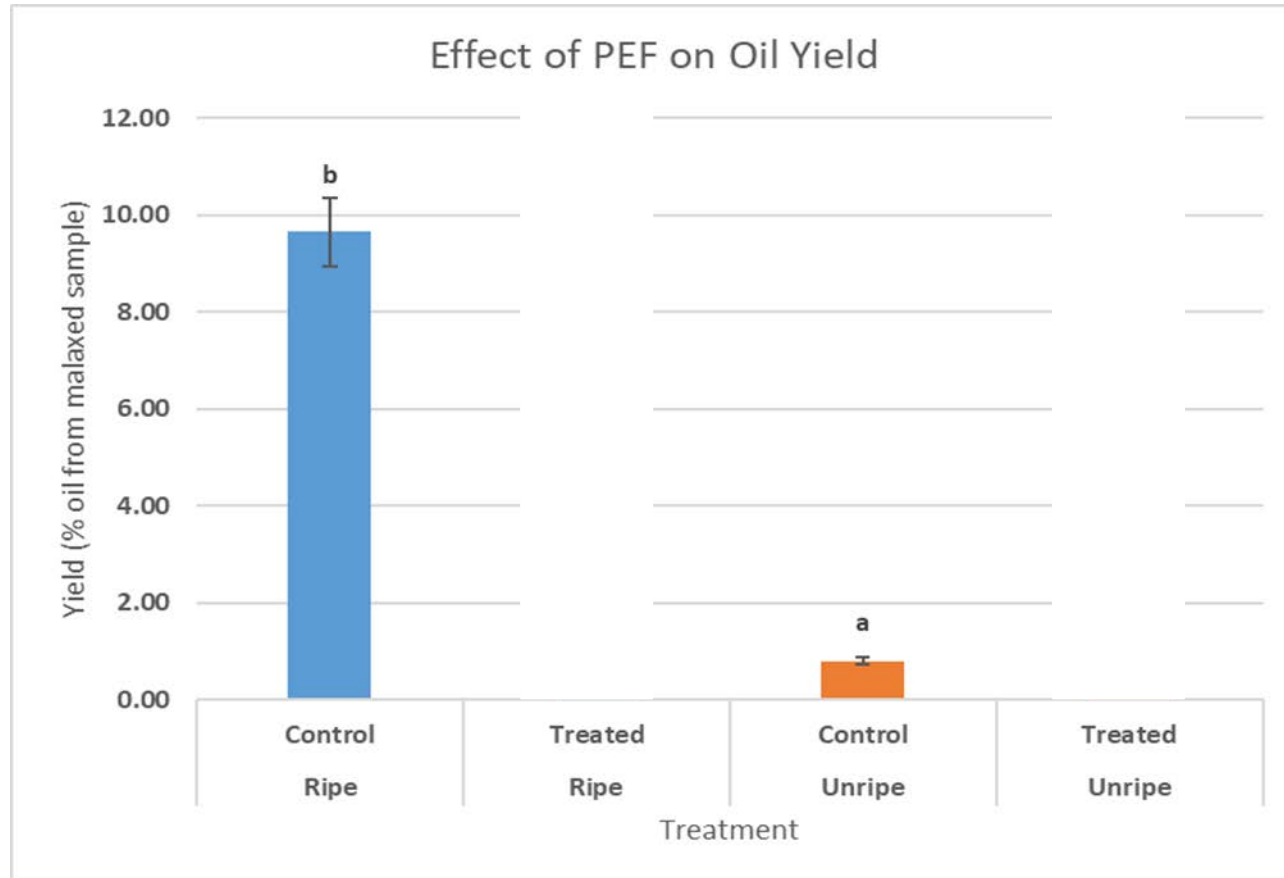
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Additional Observations



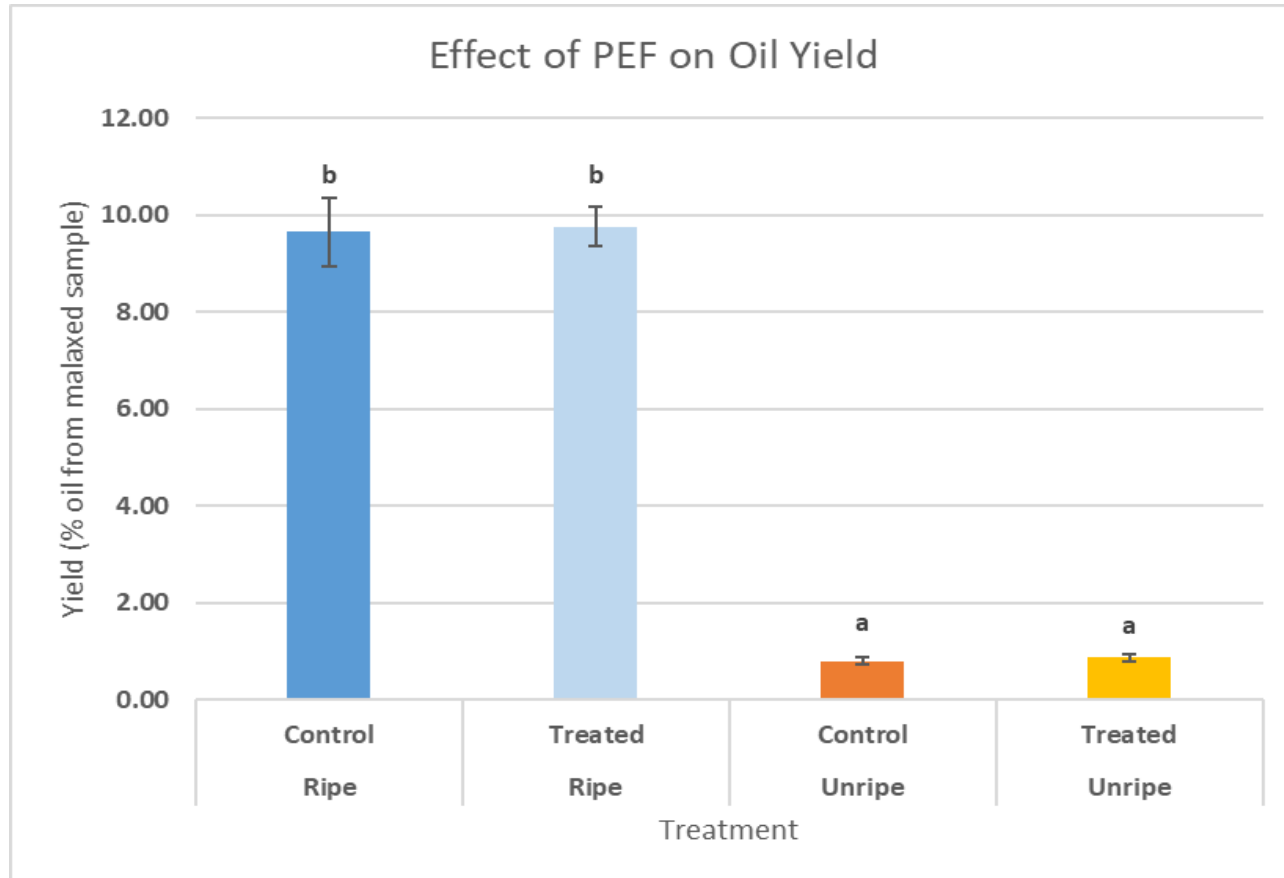
- Slight increase in fruit temperature (2°C) immediately following PEF treatment
- Fruit visibly darker following treatment – browning reactions
- Unripe treated fruit became easier to peel/destone following treatment

Effect of PEF treatment on avocado oil yield



- Oil yield from unripe fruit was very low ($\approx 1\%$ of fresh weight), while ripe fruit significantly greater yield, of $\approx 10\%$.

Effect of PEF treatment on avocado oil yield



- Oil yield from unripe fruit was very low ($\approx 1\%$ of fresh weight), while ripe fruit significantly greater yield, of $\approx 10\%$.
- There was no significant difference in oil yield between PEF-treated and untreated control fruit for either ripe or unripe fruit.



Summary



- PEF treatment increased conductivity in both ripe and unripe avocados at the 'cut' stage as well as decreased resistance in ripe 'cut' avocados
 - suggests PEF treatment affected membrane structure – i.e. “porarised”
- At later stages of processing (ground, malaxed) differences in conductivity/resistance in treated avocados in comparison to untreated controls were not significant
 - suggests that processing had a greater effect on cell structure than PEF treatment
- As expected, ripe avocado fruit had a significantly greater oil yield than unripe avocado fruit
- Unfortunately, PEF treatment did not result in increased oil yield for ripe or unripe treated fruit



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