

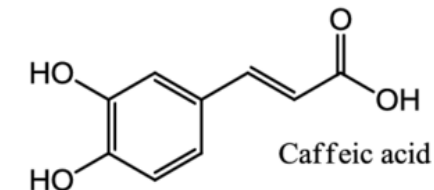
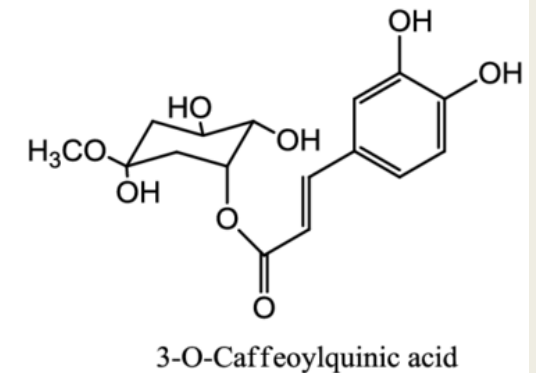
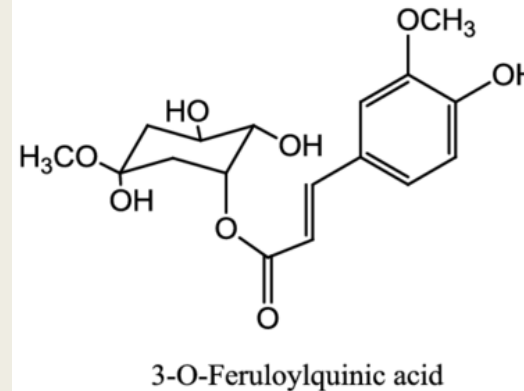
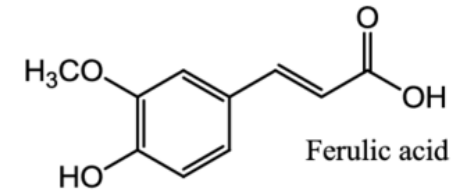
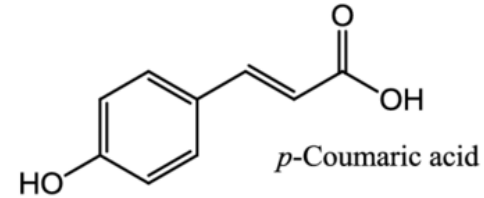
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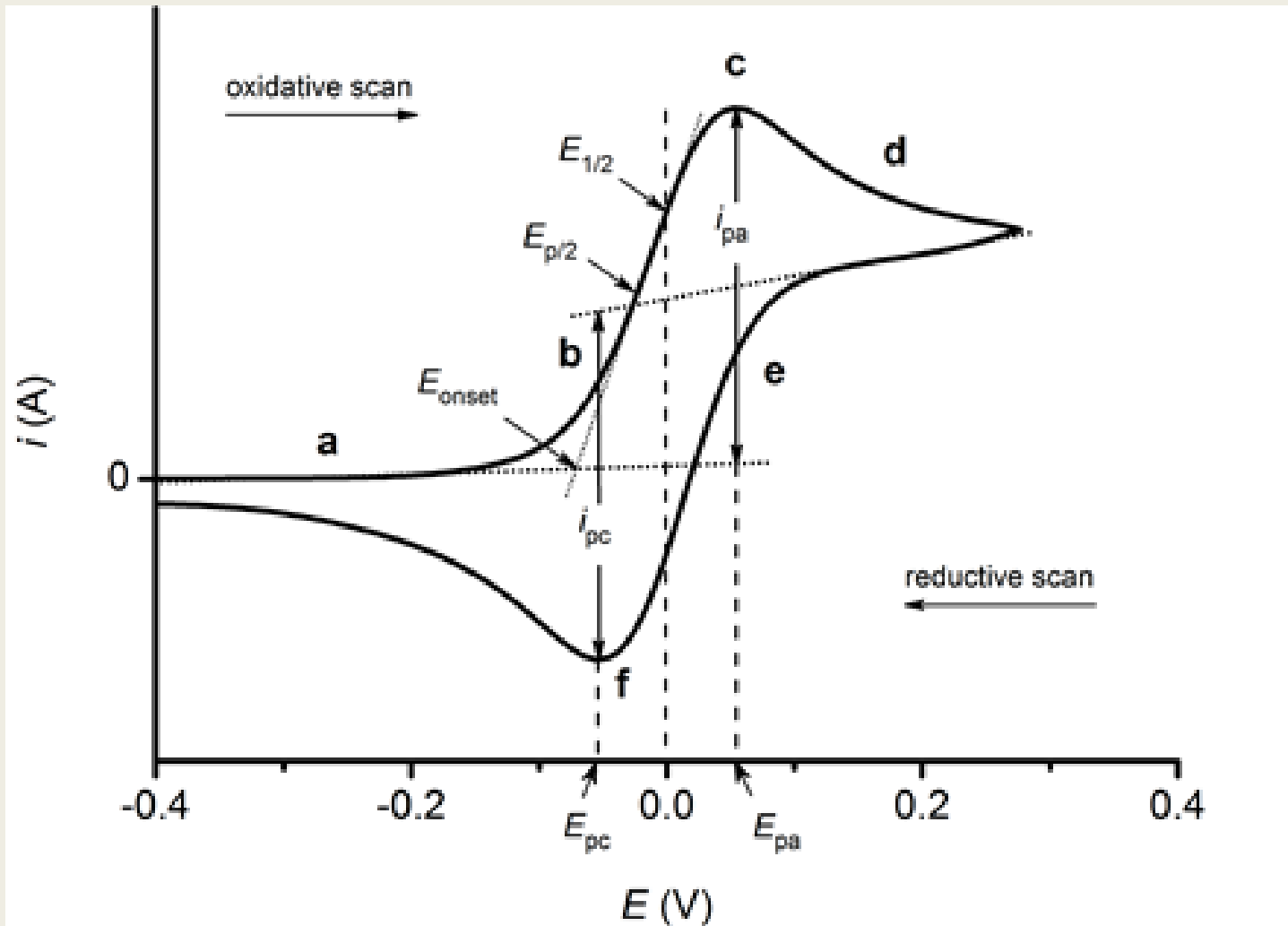
ELECTROCHEMICAL ANALYSIS OF COFFEE

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Background Information on coffee structure

- Different types of coffee have varying chemicals, with one of the components the polyphenols.
- Polyphenols are characterized by one or more hydroxy groups on an aromatic group.
- These organic compounds are electrochemically active.
- The roasting process in the preparation of coffee oxidizes these polyphenols.
- The objective of this study was to determine if there is a correlation between the chemical analysis of coffee and its variety of flavors.
- The variety of flavors we tested came from Einstein Bros. Bagels, and included Light Roast, Medium Roast, Dark Roast, and Vanilla Hazelnut.



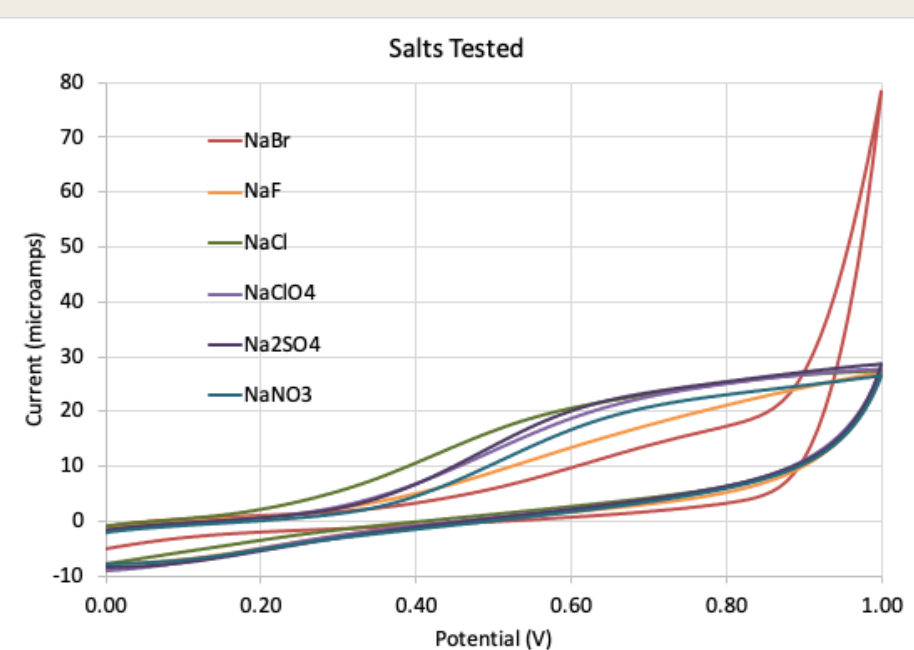
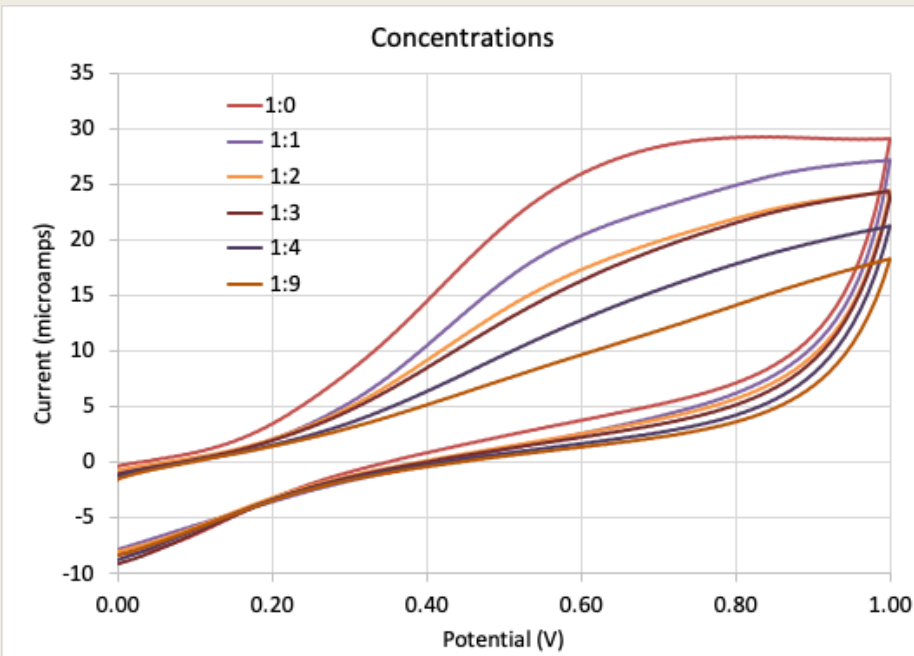


Background on Electrochemical Analysis

- Analyses of coffee utilized Cyclic Voltammetry.
- Cyclic Voltammetry(CV) measures the reduction and oxidation processes of a redox active solution.
- Electrolytes are used to balance the charges produced during the CV process.
- It was hypothesized that the varying roasting process of coffee beans would change the electrochemistry of coffee.

Concentrations used/ Salts tested

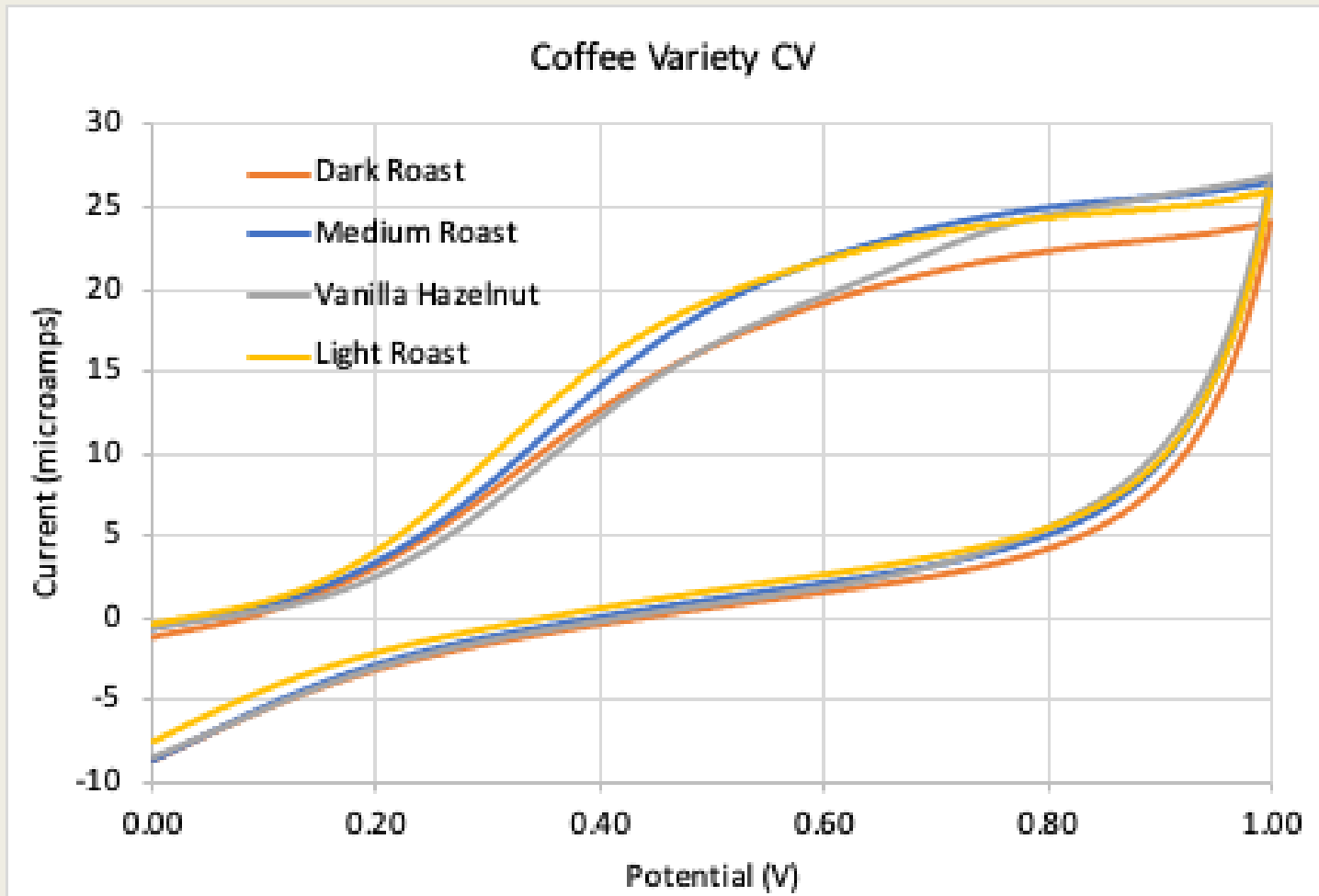
- Several different concentrations of coffee as well as a variety of salts were tested.
- Concentration ratios of Coffee:Water were 1:1, 1:2, 1:4, 1:7, and 1:9.
- Salts tested included NaCl, NaF, NaBr, NaClO₄, Na₂SO₄, and NaNO₃.
- It was determined that 1:1 ratio of coffee to water and the NaCl produced optimal electrochemical data.



	Light Roast	Medium Roast	Dark Roast	Vanilla Hazelnut
Mellowness	2	4	3	4
Bitterness	3	3	3	1
Sweetness	0	1	0	3
Richness	3	3	3	2
Acidity	3	3	4	3
Strength	3	3	4	2

Taste Test Findings

- Flavor profiles were determined by a panel of taste testers who were given specific parameters.
- Taste testers scored each coffee flavor on a scale of 0-5 in the categories of mellowness, bitterness, sweetness, richness, acidity, and strength of overall flavor.



Cyclic Voltammetry Data

- The light roast oxidizes earlier.
- The dark roast has a lower oxidation curve, meaning less current.
- Medium roast was between the light and dark roast.
- Vanilla Hazelnut has a unique oxidation curve.
- All oxidation curves consistent with quantities of polyphenols remaining after differing roasting processes.

	Light Roast	Medium Roast	Dark Roast	Vanilla Hazelnut
pH	4.68	4.65	4.55	4.56

pH Data

- The pH of the coffee varieties were very similar.
- The lower pH of the dark roast correlated with the more acidic flavor profile assigned by the taste testers.

Overall Findings

- Concentration studies showed 1:1 concentration of water to coffee gave optimal electrochemical readings.
- Salt studies showed NaCl had an increased electrochemical response in comparison to other salts studied, which was desirable.
- Taste testers concluded that the vanilla hazelnut was the preferred flavor of coffee, while the dark roast was the least favorable.
- Decrease in current was observed with an increase in roasting.
- Based on our acidity data, pH had little effect on flavor.
- Higher quantities of polyphenols remaining after the roasting process results in a more favorable flavor.