

Reminder: These notes are meant to supplement, not replace, the textbook and laboratory manual.

## Extraction: Isolation of Caffeine from Tea

1. Solvents for extraction experiments should have desirable properties. Here is a list.

For both liquid-liquid and liquid-solid extractions, the solvent should have a relatively low boiling point for easy removal by evaporation; and it should not react with any of the substances present (unless you are performing an acid-base extraction).

In liquid-liquid extraction, the compound being extracted should have a favorable distribution coefficient in the extracting solvent; in liquid-solid extraction, the solvent must dissolve the compound being extracted.

2. The caffeine extraction procedure has several features that may seem pointless at first. Here are some explanations.

Caffeine is an alkaloid, an organic base. Sodium carbonate also a base, and it is added in the first extraction to make sure that the caffeine remains in the free base form (that is, to prevent it from reacting with any acids that may be present).

An emulsion is a suspension of one liquid as droplets in another (the two liquids must be insoluble in one another). Emulsions are almost always undesirable. To avoid them, you can shake mixtures of insoluble liquids gently and add salt to aqueous layers. You will use a centrifuge in this experiment break up emulsions once they form.

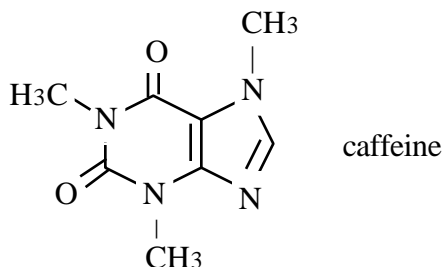
The visualization technique used in the TLC portion of this experiment involves the use of ultraviolet (UV) light. The caffeine absorbs the UV light and gives off visible light. This phenomenon is called *fluorescence*.

3. The equation for calculating the percentage of caffeine in tea is as follows:

$$\text{percentage of caffeine} = \frac{\text{amount of caffeine recovered}}{\text{weight of tea}} \times 100\%$$

There are some systematic errors in this experiment as we perform it. For example, you do not weigh the tea, you weigh the tea bag, which has not only tea but also string and paper in its weight. When you squeeze the tea (liquid) out of the tea bag, some of the liquid (containing caffeine) remains behind in the wet bag. The distribution coefficient of caffeine between water and dichloromethane is not perfect; some caffeine will remain behind in the water. Dichloromethane evaporates rapidly, cooling the watch glass as it does; water can condense on the cool watch glass, influencing the weight of your final product.

4. Here is the structure of caffeine. You should already be familiar with the other compounds used in this experiment, including dichloromethane.



5. Safety considerations for this experiment.

All of the compounds in the experiment are at least slightly toxic, even the tea (which is more basic than usual because of the sodium carbonate). Avoid direct contact with these compounds. Evaporate the dichloromethane in the fume hood, not in the open lab, to keep exposure to a minimum.