Experiment 2
Candy Chromatography – Separating and Identifying the Food Dyes

Introduction:

Chromatography:

Analysis crosses all the various disciplines of chemistry. In this experiment you are faced with a problem that is regularly encountered in any scientific laboratory: the separation of a mixture into its various components and the confirmation of the identity of the components that made up the original mixture. Whether it is detecting the presence or absence of a particular substance in a sample, identifying the products of a new reaction, or playing a chemical detective, chromatography is one of the tools often turned to. Chromatography systems normally consist of a stationary phase (can be solid or liquid) and a mobile phase (often liquid or gas). The separation is based on the interactions that the various components have with the stationary and mobile phase. Based on these interactions, the components move through the stationary phase at different rates. The stronger the interactions with the stationary phase the slower they move. The distance traveled depends on many factors including, size, type of bonding, etc. You will be using chromatography to determine the dyes used in producing the brown color in M&M's®

Chromatographic methods can be divided into two categories: column and planar. In column chromatography, the stationary phase is held in a narrow tube and the mobile phase is passed through the tube under pressure or by gravity. Gas Chromatography (GC) and High Performance Liquid Chromatography (HPLC) are just two examples of these. In contrast, planar chromatography uses a stationary phase that is supported on a flat plate or on paper. The mobile phases move through the stationary phase by capillary action. Thin Layer Chromatography (TLC) and Paper Chromatography are two examples of this. In this experiment we will be using Paper Chromatography to separate out the food colorings from the shells of M & M's® candies.

One often sees the term Rf referred to when talking about chromatography. This is simply a ratio of the distance traveled by a component to the distance traveled by the solvent. It is very dependent on conditions like the solvent system, temperature, pressure, humidity, etc. Thus an Rf value is not really transportable between experiments but the order in which the various components rise in a given solvent system does not vary and this is an important criteria that we will use in our analysis.

Finding the Solvent System:

The critical part of chromatography is finding the solvent mixture that gives the best separation of all the components in the mixture. By best separation, we mean that the various components will be separated from one another and end up located on unique areas of the chromatography paper with no (or minimum) overlap. The ideal solvent mixture is some combination of 5% NaCl(aq), H2O, Vinegar (5% CH3COOH), and 1M NH3.

Experimental Procedure

Finding the Solvent System:

Use just the brown M&M food dye since this is the one we want to determine the dyes present. The following procedure is a generic one and is equally applicable to both a pure solvent and a mixture. Your initial efforts should focus on determining the mobility and separating power of the pure solvent systems. Based on these you should be able to determine various mixtures of your four solvents that may effect a better separation. Test these out using the procedure given below.
1. Obtain a screw top jars with lid and cut a strip of chromatography paper ~2cm wide and long enough to just fit inside the screw top jar. Draw a line (with pencil) ~ 1/2cm from the bottom. This is your base line.

2. Dip a clean capillary tube into your brown dye and carefully spot it on the center of your base line on each of your strips. To effect the best separation try and keep this spot as small as possible, however you also want the concentration of the food dye to be sufficient so that you can see the colors as they separate. The best way to do this is to place a small spot on each piece of paper. Let it dry for a minute and then apply another spot. Repeat this one more time.

3. Now choose one of the solvents and add 5mL of it into the jar. Place your strip (with your initials and the solvent system written in pencil on the top) into the jar. Make sure that the solvent level is below your base line and that the paper is not touching the sides of the jar. Screw on the lid and let them develop. That is let the solvent rise to within 1/2 a centimeter of the top. This will take less than 10 minutes.

4. When the strip has developed removed it from the jar and mark the distance that the solvent traveled. Circle all observable colors and determine the respective Rf's. Sketch the chromatogram in your note book.

5. Wash out the jar with copious amounts of water and dry them.

6. Repeat this procedure with your next solvent or solvent mixture until you have found an optimum solvent system.

Confirming the Food Dye's:

You now wish to confirm the various Food Dyes associated with a brown M&M by running a chromatogram using your optimum solvent system and comparing the dye components with the other colored M&M's. You work solo on this portion of the experiment.

1. Obtain two 14x11cm strips of chromatography paper. Draw a base line this time ~2cm from the end of each. Fold each into six quadrants and as before spot each quadrant with the six dyes.

2. Place ~40mL of your optimum solvent system into the large plastic chromatography tank.

3. Place the tank in the fume hood and carefully insert your chromatography strips. Make sure that the strips are not touching the sides of the container or each other. Wrap a piece of plastic over the top of the tank.

4. When developed remove the chromatograms. Sketch the best one in your note book, record all Rf's and list the dyes that were used to give the brown color.

5. Wash the plastic tank with copious amounts of water and return it to its designated place.