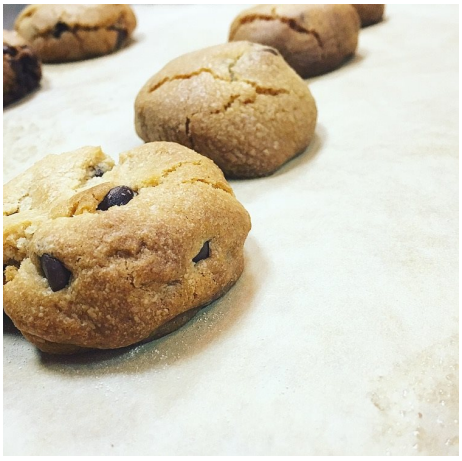
Baking the Best Cookie (whatever kind you think is best)!

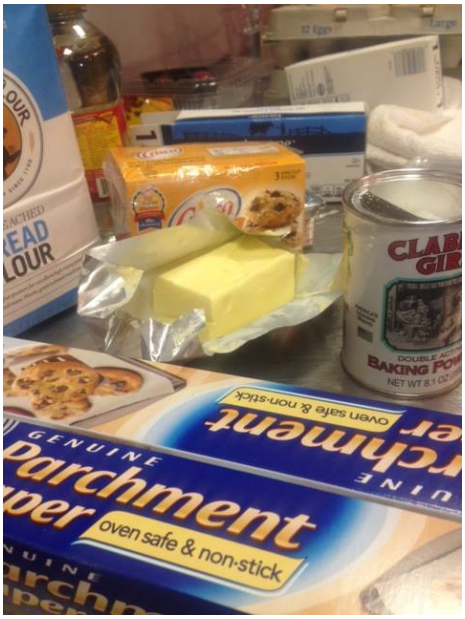
Introduction:

The search for the best cookie. For some, this is an unattainable goal. What is the perfect cookie? Soft or crispy; chewy or crisp; caked and fluffy or dense; brown and tasty or moist and light? Too many options! How do like your cookie prepared? The key to any baking is precision in measuring. You can understand this by reading a small fraction of the incredible amount of information available on measuring by volume (cups, tablespoons...) vs mass (everything measured on a scale). For this laboratory experience we will avoid such controversy and focus on the science of what goes into a cookie. Flour, sugar, butter and the source of moisture (water) all impact the final characteristics of a cookie. Review the infographic in your book on cookies and each of the components of a cookie found in Chapter 10, Breads, Cakes and Dough to read about the details of each component.



Background:

Inside a baking cookie is a pretty busy place. As a cookie bakes a few things happen. Heat will melt the fat causing the cookie to spread. Water will evaporate creating gas pockets giving rise to the cookie and dry out cookie (especially at the edges). Egg and flour proteins will denature as the cookie heats cross-linking trapping the expanding gasses. Starches will hold water by hydrogen bonding and along with proteins set giving the cookie its final shape. Leavening agents will generate gasses that, along with the water gasses will be trapped by proteins and starches giving rise to the dough. Sugar will caramelize and mix with proteins to produce Maillard brown flavors. The ratio of fats, proteins, sugars and liquid all impact each of these steps. The final characteristics of a cookie depends on the types of each component (fat, sugar, protein and liquid) are added or prepared. Carefully consider what each component brings to the party and how they interact as we create a hypothesis to experiment with baking the perfect cookie.



Choices:

Once you understand the biology and chemistry of each of the components of a cookie and how they interact and react you can begin to make choices in your cookie experiment. Review the information in the table below and using the information in our book begin to build your hypothesis to make the BEST cookie.

Fats Butter (melted, creamed, whipped or solid) Shortening Margarine	Leavening agent Baking soda vs baking powder - do you need to add an extra ingredient?	Liquid Water, eggs, milk or cream	Sugar Brown Sugar White Sugar Molasses Honey Corn Syrup
Flour All Purpose Bread Cake	Egg - whites and yolks. Each provides a different chemical characteristic to a cookie	Mixing, kneading - forming cross-linked gluten will impact the kind of cookie you make. How?	Resting the dough - Check out Harold McGee and Kengi Lopez-Alt for info.
Ratios - we will stick to the same masses & volumes for this experiment but changing the amounts and ratios of each component can have a real impact on the final cookie	Temperatures and duration - another set of important factors in making a cookie.		

Special Notes:

Fat is cookie baking.

You will make a choice of what type of fat you will use. You can choose butter or butter flavored shortening. In making this decision you should consider how the different properties of these fats might affect the outcome.

- Butter is approximately 80% fat and 20% water, and it melts at a lower temperature than shortening.
- Shortening is 100% fat and therefore melts at a higher temperature.
    - Here are some facts about shortening from the manufacturer:
    - 50% Less saturated Fat than Butter.
        - Crisco: 3g Saturated Fat per tablespoon
        - Butter: 7g Saturated Fat per tablespoon
        - Crisco contains 12g total fat per serving.

Flour in cookie baking.

The protein in the flour absorbs the liquid forming gluten. Because of this, a higher protein flour gives a drier, flatter, crisper cookie that holds together better while a low protein flour gives a softer, tender, puffier cookie as the unabsorbed liquid turns to steam puffs the cookie.

We will rank the baked cookies in terms of spread vs. puff, tenderness and color.

Mixing in cookie baking.

Mixing fat with flour limits the gluten formation since gluten formation requires water. We also know that fat is hydrophobic and non-polar, hence mixing fat with flour coats the starch granules in fat and limits the access to water.

Your part in cookie baking.

Read the background information and instructions for this laboratory including the infographics on cookies and chapter 10. This laboratory exercise requires that you work in pairs for baking, but that you coordinate with other members of your laboratory class or student groups to test several variables. Each pair of students should focus on **one** variable. One pair of students should make control cookies for the entire group or class for taste comparisons. Once the class or student groups have decided on the variable to test then you can prepare a hypothesis for each tested variable and make a prediction for the hypothesis.

Pre-Laboratory Questions and Concepts:

1. What is the specific chemical role for sugar, leavening reagent, proteins and fats in baking cookies?

2. What are the main components of flour? What is the difference between each type of flour listed in this handout?

3. There are several types of sugars presented in this handout. What are the differences? What do you predict will be the impact of these sugars?

4. Egg yolks add an emulsifying agent to cookies. What is the emulsifier? What does this emulsifier do to the final cookie?

Process of Sciences:

You will be making cookies using the control recipe. Then working with the other groups in the class each will be making a change to ONE variable. Depending on your instructor and resources, each group may make a control recipe and an experimental recipe or one group will be responsible for the control recipe. EACH group should make three or four copies of the same cookie (n=3 or 4) to prepare averages and standard deviations. The questions you have just answered should help you think about the different experiments you will be doing in this laboratory exercise. At this time, just as you have seen in the previous laboratory exercises you should create:

1. A key question being investigated for making the best cookie.

2. A hypothesis or proposed answer to the question asked based on your changed recipe.

3. A prediction for the outcome of the experiment based upon your hypotheses you developed. The prediction should written as an if/then statement and be specific to the measurements being made.

4. An explanation of your reasoning for each of your hypotheses and predictions.

Exercise 9. Baking the Best Cookie.

Common Options for Recipe (Specific options well be given by your instructor).

Butter, Margarine, I Can't Believe Its Not Butter	White, brown sugar, molasses, honey, corn syrup
All-purpose bleached flower, Cake Flower, Bread Flower	Eggs, heavy cream, whole milk
salt	vanilla
baking powder, baking soda, tartaric acid	chocolate chips
Plane and butter flavored shortening.	Walnuts

Basic (Control) Recipe

⅔ tbsp (2 tsp) butter (Cut a one tbsp square into thirds)	¼ cup + 1 tbsp white sugar
½ cup flour: All-purpose bleached flower	⅓ of an egg (1 tbsp beaten egg)
¼ tsp salt	1 tsp vanilla
¼ tsp baking powder	⅓ cup chocolate chips
3 tbsp shortening.	

Procedure

1. Preheat the oven to 375°F.
2. Sift together the flour, salt and baking powder in a medium-mixing bowl.
   This means combine the dry ingredients into the wire mesh strainer while holding it over your mixing bowl.
   Gently stir the dry ingredients until all have sifted through.
3. Using a mixer (hand or electric), cream together the fat and sugar in a large bowl until light and fluffy.
4. Add the liquid or egg and beat thoroughly, scraping down the sides of the bowl with a rubber spatula.
5. Beat in the vanilla.
6. On low speed, gradually add the dry ingredients until thoroughly combined.
   Scrape the sides of the bowl down with a rubber spatula.
7. Add the chocolate chips, beat 5 seconds on low. Use a rubber spatula to finish mixing well.
8. Cut several pieces of parchment paper to fit the baking sheet – make sure the parchment lays flat
9. Using a tablespoon, drop slightly heaped tablespoons of batter 2 inches apart onto the parchment paper.
10. Repeat for a total of 3 or 4 cookies.
11. Bake the cookies for 10-12 minutes, or until the edges just begin to brown.
12. While waiting, you can prepare the next piece of parchment paper with cookie batter.
    If the dough begins to warm too much, you can place the bowl of batter inside another bowl of ice.

13. When baked, carefully slide the parchment paper onto the cooling rack, and allow cookies to cool completely.
    You can use the rack that came with the oven. Notice that one of them has feet and will sit raised off the countertop slightly.
14. Slide the next piece of parchment with cookie batter onto the baking sheet and return sheet to oven.

The Cookie Comparison

Group of students that made different cookie batches should get together to analyze their products. Compare cookies among the class or group considering spread vs. puff, tenderness and color. Rate spread and puff with a ruler. Rate tenderness on a 1=10 scale with 1 being flat and rock hard. Rate color from 1-10 with 1 being raw, unbaked color and 10 being fully burned black. Rate taste from 1 – 10 with 1 being inedible and 10 being the best cookie ever.

Conclusions and Discussion:

1. Report the variable, hypothesis and prediction for the entire group. Organize and present the hypothesis in your report.

2. Create a table and record the width (average spread) height (average puff in the middle of the cookie) the tenderness (range from 1 (crisp) to 10 (very flexible/tender) and color (range 1-10; 1= dough colored light & 10 = dark brown/black) for EACH cookie. Rate taste from 1 – 10 with 1 being inedible and 10 being the best cookie ever. Record the average and standard deviation for each category.

3. Summarize the impact of each variable on the baked cookie results prepared in question 2. Include the impact in terms of your hypothesis and prediction.

4. What is the impact on butter preparation on the cookie?

5. How does fat impact the cookie?

6. What are the factors make a cookie dense or caked? What is the chemistry behind each kind of cookie?

7. Extend your experiment and design a follow-up experiment. Include controls and carefully supported changes/variables. What do you predict will happen in each case?

8. Re-write the recipe above to make YOUR perfect cookie. Include a short description of why you make the choice of each ingredient including the molecular science for the choice.

Process of Science Questions and Conclusions:

Earlier you created a key questions, hypotheses, predictions, and explanations for this prediction for each of the experiments in this laboratory exercise.

Based upon your data and the questions you have answered related to this exercise you should be able to complete the process of science questions and conclusions.

Answer the following questions.

1. Did your data support or falsify your hypothesis?
2. How did you come to this conclusion?
3. Did these results change your thinking about this topic? How?
4. What changes would you make to your hypothesis based on this new data?
5. What changes would you make to the experiments to better clarify your results?

References:

1. http://sweets.seriouseats.com/2013/12/the-food-lab-the-best-chocolate-chip-cookies.html
2. Bakewise - Shirley Corriher *and* Keys to Good Cooking: A guide to making the best of foods and recipes. Harold McGee