Chemistry of Brownies

Recipe:

Ingredients

- □ 1 cup (two sticks) butter - softened (if using unsalted, increase salt to 1 teaspoon)
- □ 1 cup semi-sweet chocolate chips
- □ ½ cup milk chocolate chips
- □ 1 ¼ cups sugar
- □ 1 cup brown sugar
- □ 1 tablespoon vanilla extract
- □ 3 large eggs
- □ 1 ¼ cups flour
- □ ½ teaspoon salt
- □ ½ cup unsweetened cocoa powder

Instructions

1. Preheat oven to 350 degrees and line a 9×9 inch pan with nonstick foil or parchment paper. In a large microwave safe bowl, microwave semi-sweet chocolate chips for 1 1/2-2 minutes, allow to rest for a couple of minutes before stirring until smooth.

2. Add butter, sugars, vanilla, and eggs and mix well. Whisk in flour, salt, and cocoa powder until incorporated. Stir in milk chocolate chips.

3. Transfer batter to prepared pan and bake for 35-40 minutes. *For chewier brownies, cook a little longer, closer to 40-42 minutes. For fudgier, gooey brownies, a little less cooking time, closer to 35.

4. Serve immediately with ice cream and hot fudge sauce, or allow to cool completely (best for ultra chewy brownies) before cutting into squares and serving. If you like the chewier texture but still want to serve them warm with ice cream, you can pop them in the microwave individually for about 20 seconds to heat them up.
Valentine's Day is quickly approaching, meaning that everyone in a relationship is looking for the perfect dessert to share. In my opinion, there is no better dessert out there than the perfect brownie to celebrate this romantic holiday. So, what is it that makes a brownie so delicious? The answer is that it all comes down to chemistry.

To understand the chemistry of brownies, it is first interesting to know how this scrumptious dessert came to be. Dating back to 1893, an American businesswoman at the Palmer House Hotel, Betha Plamer, yearned to create a "dessert that would be easy to transport and convenient to eat" (Jill Ang). As the head of the Board of Lady Managers for the 1893 World's Columbian Exposition, she requested that the Plamer Hotel head chef, Joseph Seyl, create just that. This raises the question, "Why is it the chef, who created the brownie, isn't the one given credit for his work" (Ang)? The answer is simple: he didn't want the credit. He wanted it to go to his employers at the hotel. Interestingly, the first brownie ever baked included not a single bit of chocolate but rather molasses. Chocolate was only added to the recipe in 1898 when a local bakery in Kansas City advertised a chocolate brownie. From that moment on, the idea skyrocketed, leading us to have the delicious brownies we know today.

Everyone has their preference for brownies: cakey or gooey, but only some know that the reason a brownie is one or the other comes down to chemistry. Gooey brownies, which I prefer, are often more fudgy and sticky due to the increased fat content since butter is used in a recipe like the one shown above.

Although the fat content determines a brownie's gooeyness or cakeyness, it contains some chemistry. This is just the tip of the iceberg. Most of the chemistry comes into play when the
brownies are in the oven. This includes leavening agents, the Maillard reaction, and
caramelization.

A leavening agent causes the batter of the brownies to release gas and expand. The most
common leavening agents used in brownies are yeast and eggs, which are naturally occurring,
and baking powder and baking soda, which are chemical leavening agents. Chemical leaving
agents like baking soda and powder react with water, salts, and acids to produce carbon dioxide,
leading to the rise of brownies. Although they are both chemical leaving agents, baking powder
and baking soda work in different fashions to cause the brownie to rise. To work correctly,
baking soda must be combined with an acid, such as buttermilk, vinegar, honey, or fruit juice.
This is because the acid aids in the breaking down of the baking soda, causing the carbon dioxide
to be released, allowing for rise. It is important to note that with baking soda, the chemical
reaction happens instantaneously; thus, once the baking soda and acid are mixed, the brownies
need to be placed in the oven immediately to begin baking.

On the other hand, baking powder contains a dried starch and acid that acts as a filler,
meaning that acid does not need to be added to the recipe. In most store-bought baking powders,
a chemical reaction occurs twice. The baking powder first reacts with a liquid and then reacts a
second time when exposed to heat. The most common organic leavening agent is yeast, a
"monocellular microorganism that reproduces by feeding on sugar, minerals, nitrogen
compounds, and oxygen (Leslie Jeon)." With natural leavening agents, fermentation breaks down
glucose into carbon dioxide and alcohol, causing the brownies to rise.

The Maillard reaction, also known as browning, is present in almost all foods where the
food is exposed to heat of temperatures greater than 140° C or 285° F. The Maillard reaction is
an interaction between an amino acid and a reducing sugar, a form of nonenzymic browning.
"The reactive carbonyl group of the sugar interacts with the nucleophilic amino group of the amino acid, and interesting but poorly characterized odor and flavor molecules result." (S===In layman's terms, the organic functional group of a carbon double bonded to oxygen reacts with the amino acid with a positively charged nucleus to make the smells and tastes of brownies we all recognize. The process of the Maillard reaction accelerates in an alkaline environment because the amino groups do not neutralize like in an acidic environment. Each food that experiences the Maillard reaction has a distinctive set of flavor compounds formed, allowing scientists to create artificial flavors similar to the food itself.

Finally, there is chemistry involved when adding chocolate flavor to brownies, whether in the form of pure chocolate or cocoa powder. When adding pure chocolate, the fat content of the brownie is increased, which adds moisture to the brownie. To counteract this, more flour must be added to balance the texture and prevent the brownie from staying wet. When using cocoa powder in brownies, there is less fat content, leading to a cakey brownie than one that is gooey and fudgy. Additionally, to add complexity to the flavor profile of a brownie, one may add vanilla extract. This ingredient must be carefully considered before being added to a recipe, as it has an alcohol base. When mixed with pure chocolate, vanilla extract will elevate the brownie's flavor; however, if added to cocoa power, a grainy brownie will result due to a process called seizing, where water-based flavoring separates molecules.

In conclusion, an extensive amount of chemistry is involved in making a brownie. So next time you enjoy this decadent dessert, remember the chemistry involved in making it!
Works Cited


