Rise to the Occasion

Jane Student
7R

Hypothesis:

The hypothesis was that if baking powder was used as a leavening agent, then it would create the highest rise.

Outline

I. Baking Success is Chemistry
    A. Chemical Changes
        1. Carbon Dioxide
        2. Baked goods rise
    B. Physical Changes
        1. Ingredients
        2. Interaction
        3. Eggs
    C. Modern Cakes
        1. Amount
        2. Role
II. Matter
    A. States
        1. solid
        2. liquids
        3. gas
    B. Properties
III. Leavening Agents
    A. Types
        1. Baking Soda
        2. Baking Powder
    B. History
    C. Characteristics
    D. Yeast
    E. Use
IV. Conclusion

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Biochemistry
Rise to the Occasion

The purpose of the experiment was to determine which leavening agent: baking soda, baking powder, or yeast, would create the highest rise. The hypothesis was that if baking powder was used as a leavening agent, then it would create the highest rise.

To conduct this experiment, flour, sugar, milk, vanilla, baking soda, baking powder, yeast, measuring cups, measuring spoons, 2 mixing bowls, a spatula, 32 cupcake liners, a cupcake pan, an oven, an electric mixer, a postal scale, and a pen were used. The procedure for the experiment was that the cupcake liners were labeled and separated into 4 groups. The oven was preheated to 177 degrees Celsius and a recipe was followed to make the batter for 6 cupcakes. 140 mL of flour was measured in a mixing bowl. In another bowl 120 mL sugar and 120 mL butter was creamed until smooth. 120 mL of milk and one egg was added to the creamed sugar and butter and was mixed with a spoon. Group A had no leavening agent added to the flour. The dry and moist ingredients were mixed until the batter was smooth and 57 g of batter was spooned into each cupcake liner for a total of six cupcakes. The cupcakes were baked for fifteen minutes. The cupcakes were removed from the oven, measured and weighed. Results were recorded and the procedure was repeated one more time. Group B consisted of 10 mL of baking powder added to the flour. Group C consisted of 10 mL of baking soda was added to the flour. Group D consisted of 1.6 mL active yeast was added. The control was Group A when no leavening agent was added. The independent variable was the different types of leavening agents used. The dependent variable was the height of the rise of the cupcake.

The conclusion was that the hypothesis was correct. Group B cupcakes, that used baking powder as a leavening agent, had the highest rise with an average of 5.0 cm height in Trial 1 and 3.9 cm in Trial 2. Group C cupcakes, that used baking soda had an average height of 4.0 cm in Trial 1 and 3.7 cm in Trial 2. Group D cupcakes that used active yeast as a leavening agent had an average height of 2.2 cm in Trial 1 and 2.0 in Trial 2. Group A, the control group, that didn't use a leavening agent had an average height of 2.1 cm in Trial 1 and 2.2 cm in Trial 2.

Log

(This is the first tab in your binder – all work done is dated and noted.)

Log

Nov 7 set up binder, and labeled tabs

Nov 14 wrote proposal form

Nov 17 researched topic
Collected information from data base on pollution and carbon monoxide

Nov 25 took notes, paraphrased. Read from my resources. Typed my notes on the computer. Researched information about plants and pollution.

Dec 1 Completed Works Cited, started taking notes from article

Dec 5 Completed outline for research paper

Dec 31, 2008- Went and bought supplies from Costco. What was purchased was: four cups of tulips that had three tulips within each cup, and gasoline for the car. The cost of the tulips was $19.99 altogether. Each plant is in healthy condition and receiving the same amount of sunlight. Took care of plants to determine how long the plants last and decide the length/time of the experiment.

January 7- Began abstract and worked on the first two paragraphs to help determine the steps needed to conduct the experiment

January 18- Bought tulips from Costco to conduct experiment. Bought 12 tulip bulbs.

January 20- Began experiment by placing the bulbs into the 4 vases and exposed the tulips for different amounts of time to the carbon monoxide. Also edited and revised my abstract. Completed the first two paragraphs. Began to work on my Science Board by printing out the procedure, hypothesis and materials. Checked over my science binder to make sure that it was complete up to this point.

January 21- Started gassing the plants labeled A, B, C. Each were gassed for as long as their designated time. At the end of the fifteen minutes of toxicating the designated plants there was no shown physical damage or unhealthiness shown.

January 22- Followed the formula for toxicating the designated plants for the same amount of time designated to each. There was no difference shown.

January 23- Followed the formula for toxicating the designated plants. There was some difference for b and c which were being toxinated for 10 and 15 minutes. They were starting to dry up and unhealthy spots were showing on there bulbs.

January 24- The same results were shown as the day before for b and c while as a and d were still showing the usual healthiness expected from a tulip.

January 26- Plants were measured and recorded. Plant D looks the healthiest and grew the most out of all the plants. Plant A is sickly and malformed but grew the second largest out of the four. Plant B grew the third most and looks almost dead. It had contracted and was turning a pale white on some parts of the stem. Plant C grew the least and was almost in the same condition as plant B but it had contracted even more and was covered the most with pale white than plant B. In conclusion the hypothesis was correct.

Research

(This is the second tab in your binder – copy of research paper, to include title page, outline, and works cited.)

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There are two different types of people in the kitchen. There are cooks and there are bakers. When baking is a success it is because of chemistry.

Baking includes physical and chemical changes. A chemical reaction occurs when cake is baked in the oven. There are different kinds of leavening agents used in baking that contribute to a chemical reaction. Some baked goods rise and some don't and there is a reason why this happens. Leavening agents are responsible for making baked goods rise. The way that a leavening agent, like baking soda, works is that gases called carbon dioxide are formed when it is mixed with a liquid. When it is heated, gas creates bubbles or air and makes the baked good rise instead of remaining flat. Baking powder, another leavening agent, also creates a chemical reaction. First the baking powder reacts to a liquid which makes tiny air bubbles of carbon dioxide in the batter or dough. These bubbles make the dough or batter rise. Then the heat from the oven creates more carbon dioxide which makes the gas expand and create steam. The pressure creates the whole thing to rise (Helmenstine 1). These are two examples of how a chemical reaction occurs when cake is baked. The leavening agents contribute to the chemical reaction.

Baking is not only a chemical change. It is also a physical change. When ingredients are mixed in a bowl there is a physical change. The mixing of ingredients affects the chemistry of the cake. Some of the ingredients are flour, gluten, butter and sugar. Each ingredient has a different role or job. Eggs are protein and butter is fat. Flour, specifically wheat flour is a common powder of starch and protein. Flour gives baked goods structure. There are 2 proteins in flour called glutenin and gliadin. Gluten provides an elastic ability. The best cakes come from flour that is low in protein. These proteins bond together when water is added and make gluten. Kneading dough also

proteins bond together when water is added and make gluten. Kneading dough also makes gluten. The heat of the oven turns the protein and starch of the flour into the "sturdy webbing inside a loaf of bread (Stewart 2.)" Pastries have lower protein and less gluten and more crumbs. It is important to find the right flour to use to make the right pastry. The amount of protein in flour affects the finished product.

All of the ingredients affect the chemistry of the cake. There is a chemical change when certain ingredients interact and are exposed to heat. One example is when batter is heated. The sugar or sucrose breaks down into fructose and glucose which gives the cake its brown crust. When baking soda is heated it creates CO2 gas and bubbles in the cake. The salt slows down the CO2 and helps to make sure that the bubbles don't get too big (Campbell 3). This makes the cake lighter. Fats like butter keep croissants light.

Eggs have many different jobs. The yolk holds the cake together and makes it moist and rich. The egg whites support the bubbles and can act as a leavening agent when beaten. They also help bind ingredients together. Protein in egg whites can make pastry fluffy but it can also make it dry. Eggs are important.

Modern cakes are usually leavened with baking soda, powder or beaten eggs. Baking soda reacts with acids like buttermilk, chocolate, honey and citrus. It creates carbon dioxide which puffs up the batter. Double acting baking powder reacts twice. It reacts with the heat in the oven and it reacts with liquids during mixing (Stewart 4). When cakes or baked goods are heavy, it is usually because too much of a leavening agent was added. Large amounts of leavening agents make too many bubbles that pop and make the baked good dense. There is a proper amount to use. 1 cup of flour can be leavened by 1 tsp of baking powder or ¼ tsp of baking soda. Sugar adds sweetness and

also makes baked goods moist. Milk also adds moisture. Both milk and sugar prevent too much gluten from forming. Salt helps make the gluten more elastic because it bonds with the gluten. It also helps the taste from being too sweet. When a liquid isn't used then beaten eggs are usually the leavening agent. An example of this is angel food or sponge cake.

Ingredients are different types of matter. There are three types of matter. The three types of matter are solid, liquid and gas. Volume defines matter by its shape and how much space that it occupies. Solids have a definite shape and volume, liquids have a definite volume but not shape and gases don't have a definite shape or volume. Different substances have different properties. One property is solubility. Solubility is a term that means the amount of a substance that will dissolve in 100 grams of a solution at a certain temperature (Linker 13). A change in temperature can change the solubility.

Mass is a physical characteristic of a property. Mass is the amount of matter in an object. Density is another property. Density is the amount of mass compared to the volume. Density changes when a substance changes into a different state of matter. The temperature when a liquid changes to a gas is called the boiling point. When a solid changes to a liquid is called the melting point. These properties are used when baking.

"A chemical change is when a substance changes into a new substance with different characteristics (Linker 20)." Chemical changes cannot be reversed. Cooking a marshmallow so that it turns brown on the outside is a chemical change. Physical changes happen when it looks different but the substance doesn't change. Adding salt to water is a physical change. It can be reversed. Physical changes can be detected with the senses. Color, odor, roughness, and texture are ways to determine a physical change.

There are different kinds of leavening agents. Some examples of leavening agents are baking soda, baking powder and yeast. Leavening agents have been around for up to 5,000 years. Egyptians and Mexicans used yeast as a leavening agent. In 1850 baking powder started to be used more often. Self-rising flour which is flour mixed with baking powder also became popular. Sodium carbonate is baking soda and in 1867 it was sold in the store under the Arm &Hammer label. In 1889, Wright created double acting baking soda under the Calumet label (Foot 1). Leavening agents became more accessible and popular through the years. Leavening agents contribute to chemical changes.

What is baking soda and baking powder? Baking soda is bicarbonate of soda. It is an ingredient of baking powder. If it is mixed with an acid and it creates bubbles which make dough rise or batter rise. It is an alkaline. Baking powder is a combination of acid and alkali (baking soda). There are 3 kinds of baking powder. The first is double acting. It is called this because gases are released on contact and also when it is heated during baking. The second is Tartrate. Tartrate creates gas when it comes in contact with something wet. The third is phosphate, a single, slow acting powder (Foot 1-2). Double-acting is the most commonly used baking powder. It loses its potency over time. One way to check the strength of baking powder is to pour water over a teaspoon of the baking powder and see if it bubbles. If it bubbles than it is still potent. Baking powder can be made with baking soda and cream of tartar. Add one part of baking soda and two parts cream of tartar together and it becomes baking powder.

Another type of leavening agent is yeast. It is an organism. When yeast is added to sugar and water is activates and it also thrives on starch. It is hard to work with yeast when baking for several reasons. Yeast dies when it is cooked. 100-115 *F is the best

temperature for growth. The best temperature for leavening though is 80-95*F. If yeast grows too fast then there are too many air pockets. This creates a hollow loaf of bread or a hollow cake. Yeast dies at 120*F so it needs to rise in a place where the temperature is regulated. Yeast is a single cell plant. New buds are formed and they live when it is moist and warm. Refrigeration slows down the growth. Yeast feeds on sugar. CO2 is created when yeast is activated which can make the dough or batter usually double in size. Dough has to be kneaded to distribute the CO2 evenly and then left to rise again (Foot 2). If a mixture is left too long it becomes sour. Salt prevents yeast from growing but it adds flavor. Sugar isn't necessary in baked goods for leaveners but it improves taste and it makes it tender. Too much sugar can slow the growth of yeast also. It is important to balance salt and sugar when working with yeast. It can be a challenge to bake with yeast but it is one type of leavening agent.

Baking soda and baking powder are similar in many ways. Both are used as leavening agents. They are added before cooking to make the batter rise. They make the batter rise by producing CO2 bubbles. They are used under different circumstances. Baking soda has to be mixed with an ingredient that has an acidic ingredient and that is moist for it to create the CO2. A chemical reaction occurs when it is combined with these things. The CO2 begins right on contact so the batter has to be baked immediately for it to work as a leavening agent (Atkin 1). Baking powder is single acting or double acting. Single acting is activated by moisture but double acting reacts two different times. The first time is when it is added to the dough. The second time is from the heat in the oven. Some recipes use baking soda and some use baking powder. It depends on the other ingredients that are used in the recipe as to which leavening agent is used.

Baking soda will make a recipe bitter unless it is used with something acidic like buttermilk. Baking soda is used in cookies. Baking powder is used more in cakes and biscuit recipes. Baking powder has an acid and a base so there is a more even taste to it. Baking soda can't be use in place of baking powder but two parts of cream of tartar combined with 1 part of baking soda will make baking powder.

Ingredients, leavening agents, chemical and physical changes are important when baking. It is important to understand the chemistry of baking because it contributes to success.

Works Cited

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Experiment & Data

(This is the third tab in your binder – your abstract goes here)

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The conclusion was that the hypothesis was correct. Group B cupcakes, that used baking powder as a leavening agent, had the highest rise with an average of 5.0 cm height in Trial 1 and 3.9 cm in Trial 2. Group C cupcakes, that used baking soda had an average height of 4.0 cm in Trial 1 and 3.7 cm in Trial 2. Group D cupcakes that used active yeast as a leavening agent had an average height of 2.2 cm in Trial 1 and 2.0 in Trial 2. Group A, the control group, that didn't use a leavening agent had an average height of 2.1 cm in Trial 1 and 2.2 cm in Trial 2.

Graphs & Charts

(This is the fourth tab in your binder – you MUST have at least one chart and one graph for your collected data)

Days	Plant A	Plant B	Plant C	Plant D
1	healthy	healthy	healthy	healthy
2	healthy	healthy	healthy	healthy
3	healthy	shriveling	shriveling	healthy
4	healthy	contracting	contracting	healthy
5	Turning unhealthy	withering	withering	healthy
6	Sickly and malformed	dying	dying	healthy
7	Sickly and malformed	dying	dying	healthy

Air Quality Index Values	Levels of Health Concern	Colors	Meaning
0 – 50	Good	Green	Air Quality is considered acceptable, and air pollution poses little or no risk
51 – 100	Moderate	Yellow	Air quality is acceptable; however, for some pollutants there may be a slight health concern for a very minimal group who are unusually sensitive to air pollution
101 – 150	Unhealthy for sensitive groups	Orange	Members of sensitive groups are affected and may experience health problems. The general public will most likely be not affected
151 – 200	Unhealthy	Red	Everyone may begin to experience health problems; members of sensitive groups may experience serious health issues
201 – 300	Very Unhealthy	Purple	Health alert: everyone may experience more serious health effects
301 – 500	Hazardous	Maroon	Health warnings of emergency conditions. The entire population is more likely to be affected

Trial 1

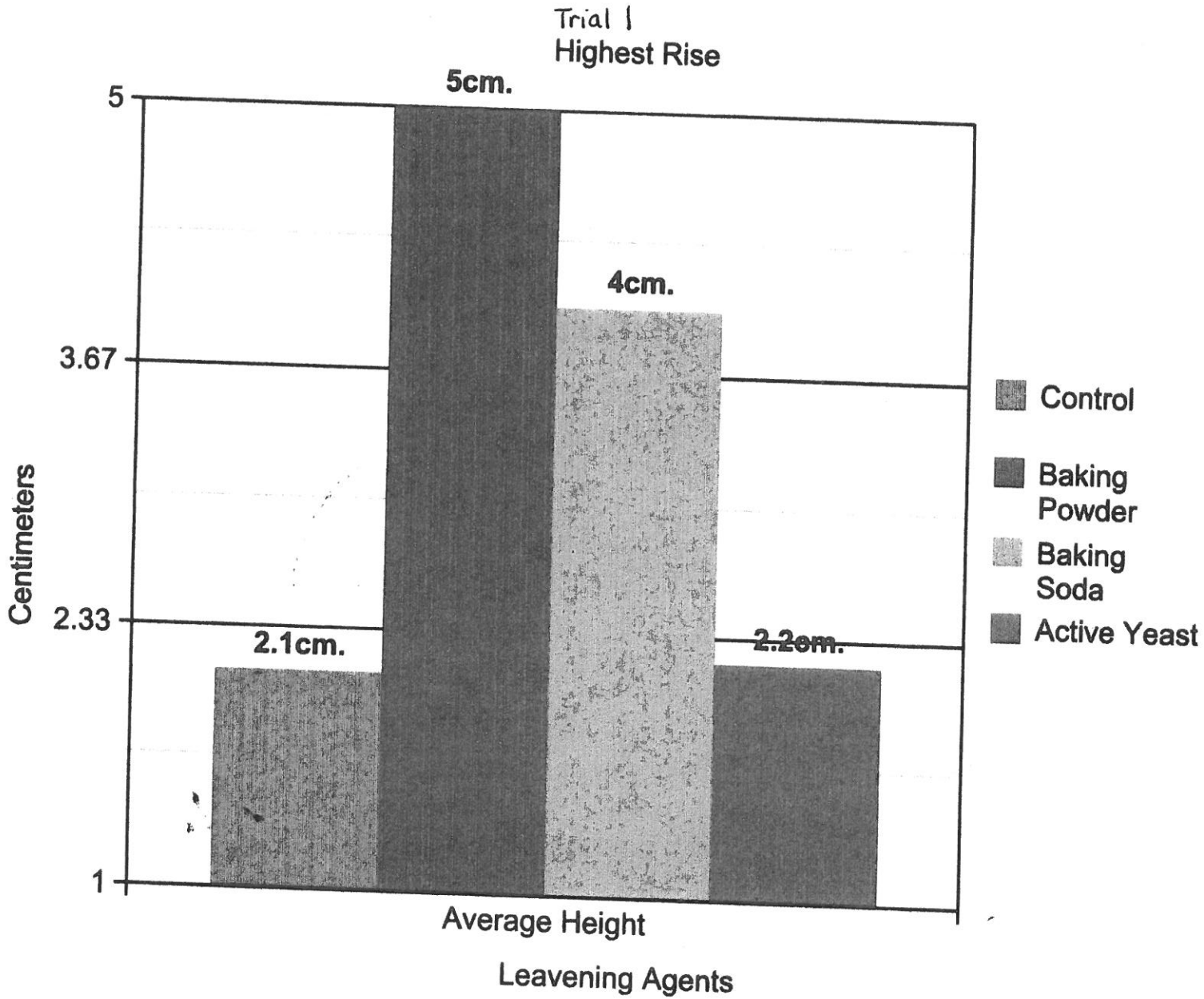
Height of Rise In Centimeters

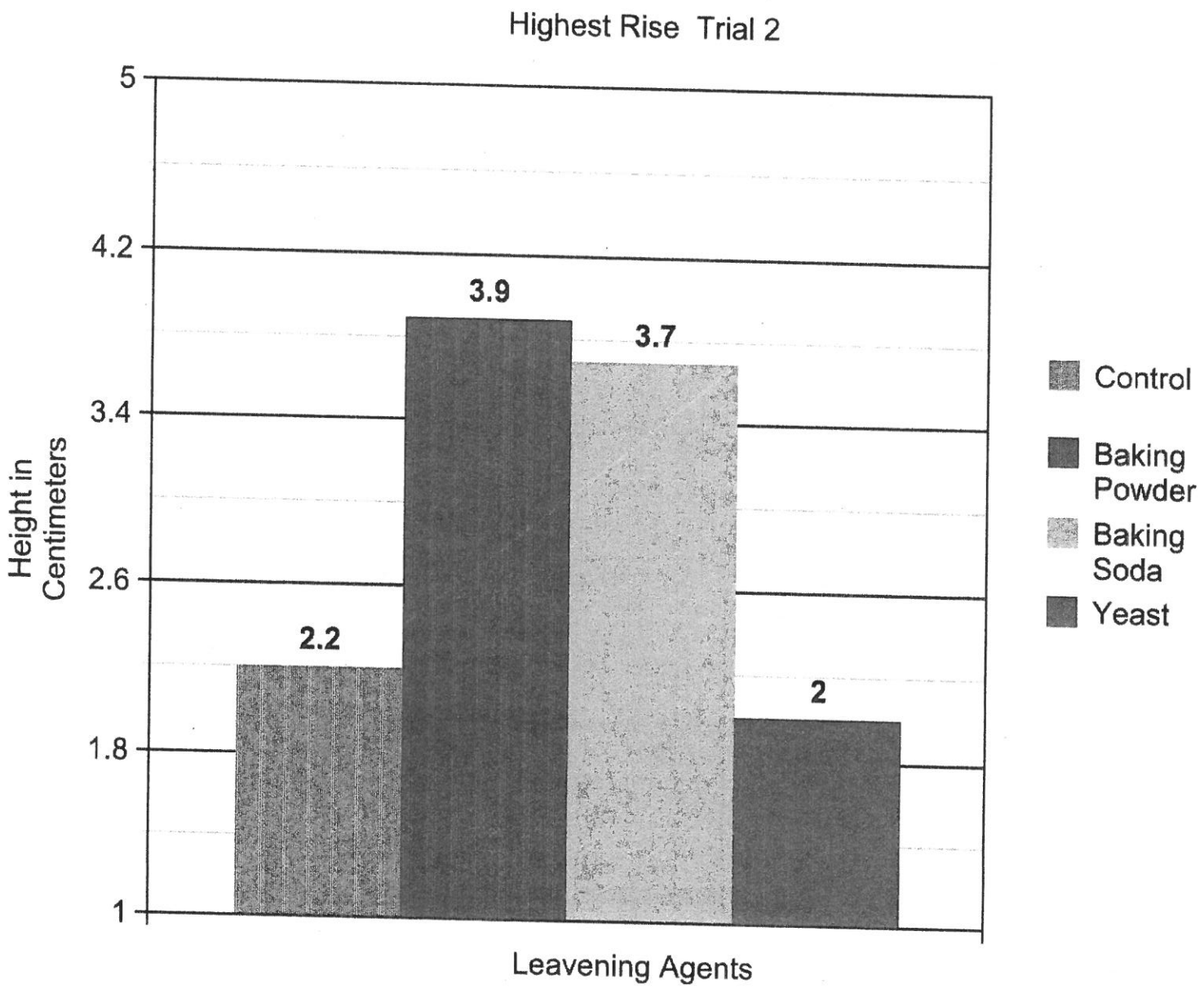
	Control	Baking Powder	Baking Soda	Active Yeast
cupcake 1	2.3	4.2	4.1	2.2
cupcake 2	2.1	4.2	4.0	2.3
cupcake 3	1.9	4.5	4.0	2.1
cupcake 4	2.3	4.7	4.1	2.4
cupcake 5	2.0	4.4	3.9	2.1
cupcake 6	2.1	4.2	3.9	2.0
Average	2.1	4.4	4.0	2.2

Trial 2

Height of Rise in Centimeters

	Control	Baking Powder	Baking Soda	Active Yeast
cupcake 1	2.4	3.9	3.6	2.0
cupcake 2	1.9	4.0	4.0	2.0
cupcake 3	2.1	3.9	3.5	2.0
cupcake 4	2.2	3.7	3.5	2.0
cupcake 5	2.3	3.7	4.3	2.2
cupcake 6	2.0	3.9	3.5	2.0
Average	2.2	3.9	3.7	2.0


Trial 1
Highest Rise
5cm.
4cm.
2.1cm.
2.2cm.
5
3.67
2.33
1
Centimeters
Average Height
Leavening Agents
Control
Baking Powder
Baking Soda
Active Yeast


Highest Rise Trial 2
5
4.2
3.4
2.6
1.8
1
Height in Centimeters
2.2
3.9
3.7
2
Leavening Agents
Control
Baking Powder
Baking Soda
Yeast

Work Cited

(This is the fifth and final tab – Please cite all sources. Your sources should be credible and reliable, i.e. sciencenews.org. You may use www.scholar.google.com to find additional sources.)

Works Cited

Atkin, Ross. "Baking Soda: A Frugal Friend." *EBSCOhost*. Ebsco Industries, Inc. 2009. *Middle Search Plus*. Web. 14 November 2009. http://web.ebscohost.com/ehost/detail?vid=5&hid=113&sid=1b9efa0d-37b7-449f-abeb-ea0665d37de2%40sessionmgr114&bdata=JkF1dGhUeXBlPWNvb2tpZSxjcGlkJmN1c3RpZD1zNDEzMjE0NiZsb2dpbnBhZ2U9Y3BpZGxvZ2luLmFzcD9jdXN0aWQ9czQxMzIxNDYmc2l0ZT1laG9zdC1saXZl#db=mih&AN=1165788#db=mih&AN=1165788

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