Cookie Science:

More than JUST Cookies!

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Cookies 101

Flour

- STRUCTURE
- Absorbs liquid
- Cake – finer and lower protein
- All-purpose – protein level depends on the brand
- Bread – thicker, chewier texture, higher protein
- Bleached flour – can absorb more liquid, color

Sugar - Function

- Sweetness
- Texture
  - Moistens – liquefies when heated
  - Tenderizes – sugar is hygroscopic, so it prevents water from being used for gluten development
- Leavening during creaming through air incorporation
- Color – browns through caramelization and Maillard browning

All things sugar resources: chsugar.com, dominosugar.com, sugar.org

Sugar - Types

- Granulated – made from sugarcane or sugar beets
- Brown – granulated sugar + molasses
  - More butterscotch flavor and draws in more moisture due to molasses
  - Dark has more molasses
- Powdered sugar – more finely ground than granulated sugar

Fat - Function

- Tenderizes – coats starches and proteins to prevent gluten development
- Creates sensation of being moist because can’t be absorbed by starches or proteins
- Leavens – creaming incorporates air
- Flavor – most often flavor, all fats contribute richness
- Browning – milk solids in butter Maillard reaction

Fat - Types

- Butter
  - Melting point (90°F) similar to body temperature so melt-in-you mouth sensation
  - CRUCIAL to outcome of cookie dough
  - Room temperature
    - Gives slightly when pressed with your finger but still hold its shape
    - Flexible but no cracking
    - 65-67°F
    - Optimal temp in order to incorporate enough air in creaming and keep cookies correct thickness
    - Better to be too cool than too warm

Fat - Types

- Shortening – 100% fat, no water
  - Higher melting point (110-120°F) so…
    - Leaves film in your mouth
    - Thicker texture
    - Lacks flavor
- North American butter – at least 80% butterfat
- European butter – minimum 82% butterfat
  - Smoother, creamier mouthfeel
  - Lower water content – firmer and slower to melt; effects end results in baking
- Use unsalted butter! No industry standard for how much salt is in a pound of salted butter


KING ARTHUR
BAKING COMPANY
THE ESSENTIAL
COOKIE COMPANION
REVISED AND UPDATED


ROOM TEMP. BUTTER
SHORTENING
OLIVE OIL
COCONUT OIL
BROWNED BUTTER
KingArthurBaking.com

Tricks to Softening Butter

- Microwave – be careful!!
  - Microwave 5 second intervals while turning the stick of butter each time
- Cube
  - Cut butter into smaller pieces and let it sit until reaches cool room temperature
- Cream butter by itself before adding sugars

Eggs - Function

- Structure (egg white)
  - Proteins act as tougheners
- Fats and emulsifiers (egg yolk)
  - Lecithin – emulsifier found in the egg yolk
    - Retains moisture and slows staling
  - Tenderize
  - Chewier cookie
- Usually large eggs are used in baking but use what the recipes calls for

Parts of the Egg

- White
  - Mainly moisture
  - Some protein
  - No fat
  - Structure and moisture
- Yolk
  - Some protein
  - Less water
  - All of the fat content of an egg
  - Contains the emulsifier (lecithin)
  - Tenderness and richness

Fresh Egg – Test

- Place egg in bowl of water
- Lays on side at bottom – still very fresh
- Stands upright on bottom – still fine to eat but should be used soon
- Floats to top – not good for eating and should be discarded

Leavening

- Physical – air incorporation during creaming
- Chemical – baking soda, baking powder
- Flat, coarse final product – not enough leavening
- Collapsed after baking – too much leavening

Baking Soda

- Alkaline
- Activated by liquid and acid present
- Acid ingredients – buttermilk, sour cream, yogurt, lemon juice, vinegar, brown sugar, natural cocoa powder (not Dutch)
- Too much – metallic flavor
- Elevates pH, brown color, more spread
- 4 times stronger than baking powder

Baking Powder

- Baking soda, acid, starch
- Usually double acting
  - First reaction – when combined with liquid
  - Second (slower) reaction – heat from the oven
  - Creates lift and thickness

Baking Powder and Baking Soda: What's the Difference?
https://www.homebaking.org/wp-content/uploads/2019/07/bakingsodavsbakingpowder.pdf

Other Ingredients

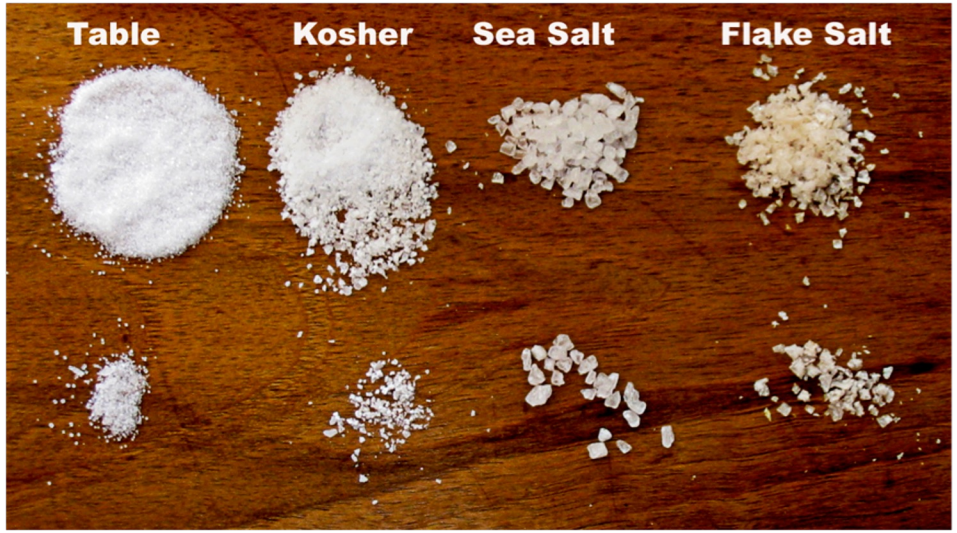
- Bittersweet and semisweet chocolate – no regulation to distinguish (look at packaging to determine % of chocolate), both must contain at least 35% pure chocolate
- Milk chocolate – at least 10-15% cacao
- White chocolate – no chocolate solids; cocoa butter with dry milk powder, vanilla, soy lecithin
- Coating chocolate – not real chocolate, cocoa butter has been replaced by other fats, doesn't require tempering to hold its formed shape
- Melted chocolate – do not use chocolate chips (cocoa butter is often times replaced with hydrogenated oil)! Use freshly chopped baking chocolate to ensure it melts smoothly

Other Ingredients

- Natural cocoa powder – highly acidic
- Dutch process cocoa powder – slightly acidic because treated with alkali to neutralize acidity; more mellow flavor
- Nuts, black walnuts- toasted vs. raw

Salt

- Enhances sweetness
- Fine sea salt best for baking
- Can also use table salt
- If use kosher, use a bit more
  - 1 tsp. table or fine salt = 1 ¼ tsp. kosher salt



Equipment

- Kitchen scale
- Portion scoop – even baking
- Oven thermometer – place in center of the middle oven rack to ensure oven temperature is accurate
- No dark pans to prevent overbrowning
- Cooling rack

Preheat

- Preheat oven – after the beep, wait 15 minutes to ensure oven has actually preheated
- Use an oven thermometer

Measuring

- Scale your ingredients! - ACCURACY
- Whisk dry ingredients to remove clumps and ensure leaveners are evenly distributed

Temperature of ingredients

- Cool room temperature
  - Butter - 67°F
  - Eggs

BAKING TEMPERATURES

Ingredient and Process Temperatures

Cutting in Butter	35 - 40°F	(2 - 4°C)
Creaming Butter	65 - 75°F	(20 - 21°C)
Blooming Instant Yeast (Water Temp)	85 - 100°F	(29 - 38°C)
Blooming Dry Active Yeast (Water Temp)	105 - 115°F	(41 - 46°C)
Yeast Flour Blend (Water Temp)	120 - 130°F	(49 - 54°C)
Dough Proofing (Proof Box Temp)	80 - 90°F	(27 - 32°C)
Dough Proofing (Proof Box Humidity)	80 - 90%	

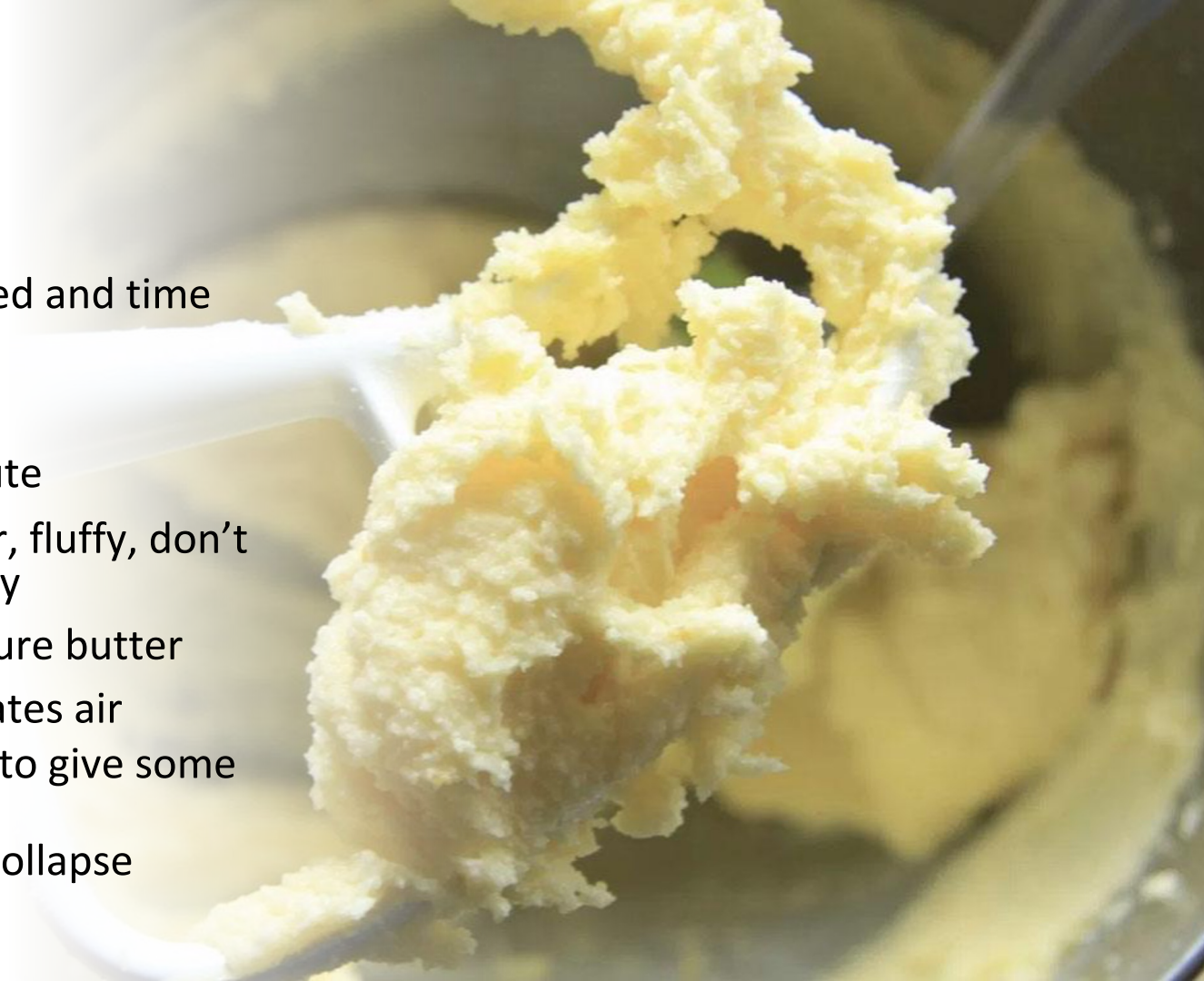
Check Your Altitude

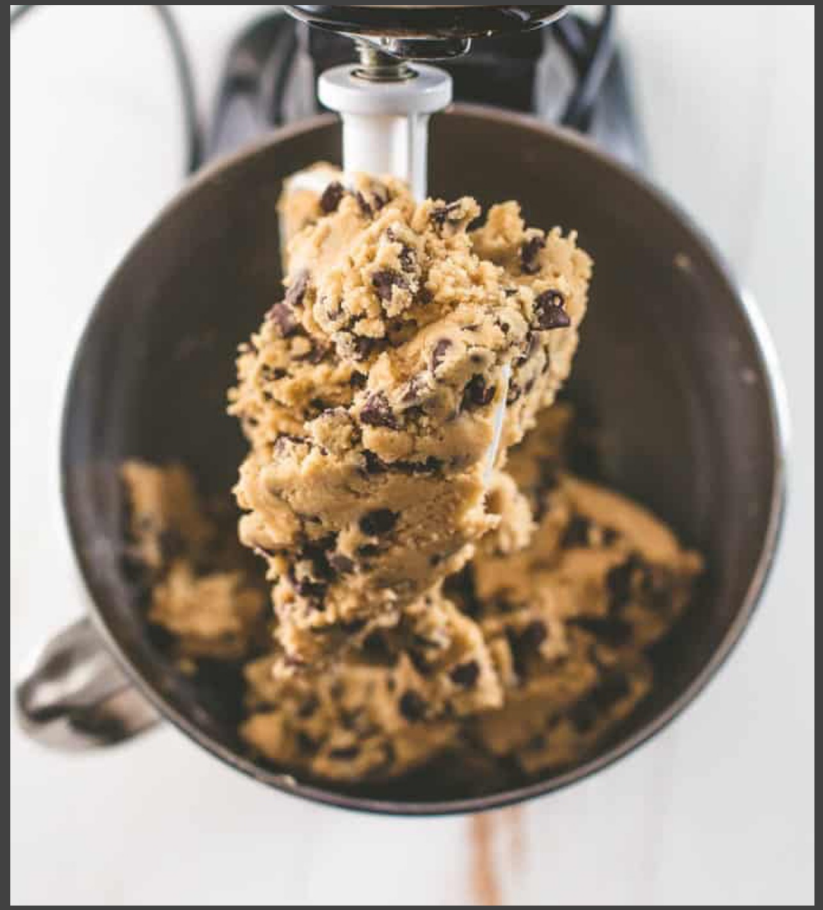
Decreased air pressure at elevations above 3,000 ft. can increase the evaporation of liquids and the expansion of gasses. Increase *oven baking temperature* by 10-25°F (5 - 14°C). See thermoworks.com/high-altitude/.

Doneness Temperatures*

Creaming

- Pay attention to speed and time
- Medium high
- 2-3 minutes
  - Scape every minute
- Smooth, pale in color, fluffy, don’t want it sandy or gritty
- Cool room temperature butter
- Blends and incorporates air
  - Want enough air to give some lift
  - Too much air → collapse



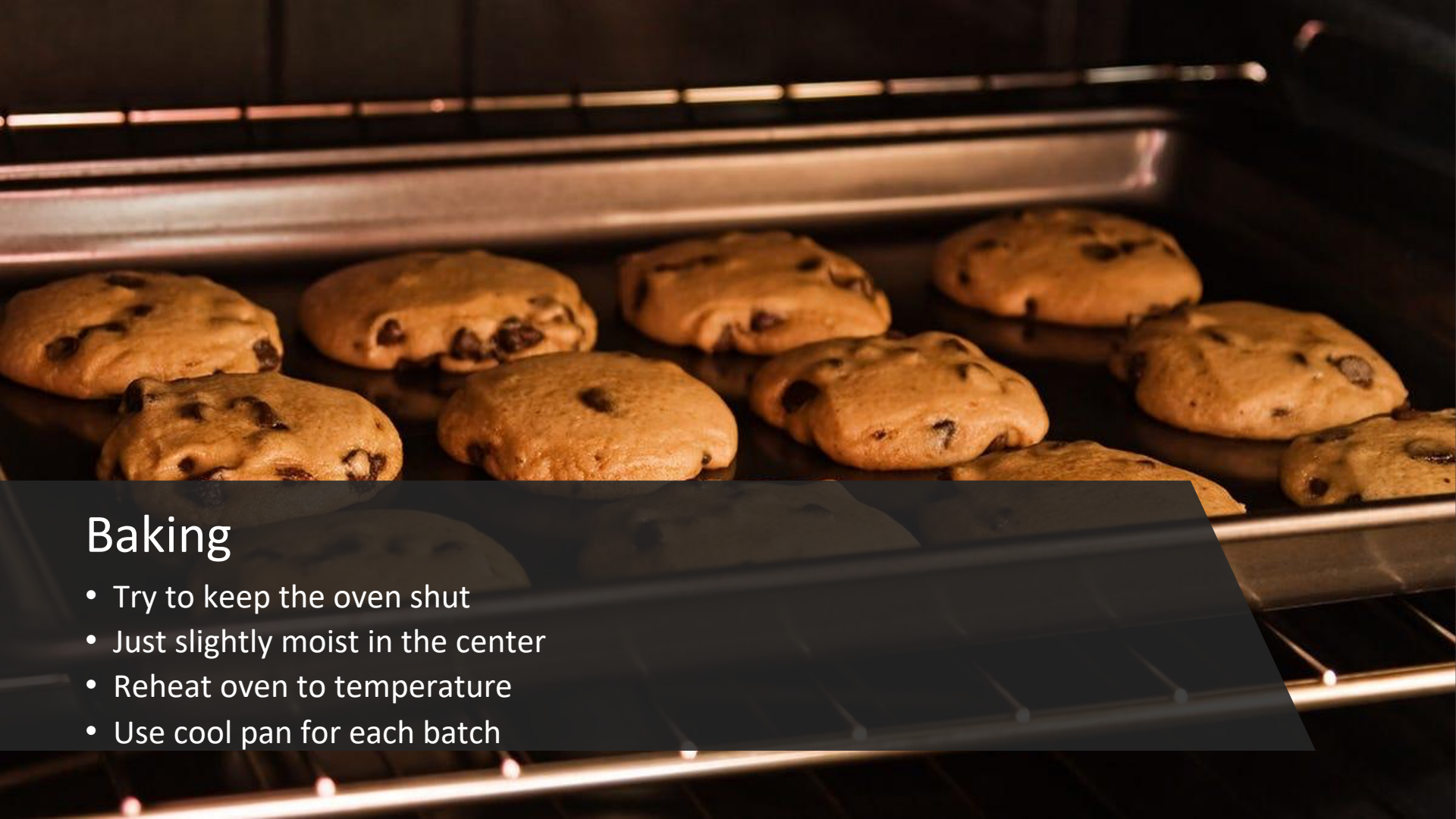


Mixing

- Eggs one at a time
  - Thoroughly combine
  - Scrape after each
- Slowly add dry ingredients, mix until just combined
- Slowly stir in mix-ins

Shaping

- Use portion scoop, level off
- Even baking
- Don’t overcrowd the pan
- Some recipes may call for you to slightly press down



Baking

- Try to keep the oven shut
- Just slightly moist in the center
- Reheat oven to temperature
- Use cool pan for each batch

Cooling

- Cool as long as recipe says to on pan
- Then continue to cool with cooling rack
  - Cools more quickly and evenly, avoids too much carryover baking

Baking resources

https://www.dominosugar.com/baking-tips-how-tos/tips-tricks-cookie-baking-bliss

GRAIN CRAFT

Baking sheets and pans of shiny, heavy-gauge aluminum bake cookies and bars more evenly than thin, dark metal or glass pans. ***Choose*** baking sheets that are the right size for your oven, allowing at least 2 inches of space between the sides of the baking sheet and the oven walls or door.

Grease baking sheets only when a recipe recommends it. Some cookies spread too much if the sheet is greased. When the recipe calls for non-greased baking sheets, cool and wash them between batches.

To achieve the right oven temperature before baking, ***preheat*** your oven for about 10 minutes. Bake cookies or brownies on the middle rack of the oven, one pan at a time, to prevent over-darkened bottoms and uncooked tops.

For evenly shaped cookies, ***try a scoop***. When a recipe calls for rounded tablespoons of dough, use a 1- or 1½- inch diameter scoop with dough leveled.

Check cookies and bars for doneness at the minimum baking time stated in the recipe. Remember, cookies continue to bake slightly after they are removed from the oven.

To ***prevent*** cookies from ***spreading*** too much on warm or humid days, spoon the cookie dough onto the baking sheets; ***chill the dough*** for a few minutes before baking.

Looking for a great tasting and dependable cookie flour?

Try Grain Craft's White Spear Pastry Flour - preferred by cookie bakers for its spreading characteristics in both drop and wire cut applications. Or if you are looking to bake a smaller diameter cookie, try our Pastry/Mayfair Pastry flour.

#iheartgluten

graincraft.com

Plating

- Portion scoop
- Roll the dough between your palms for most cookies
- Garnish – with more mix-ins
- Reshape – use a biscuit cutter to even out any misshapen edge

Freezing Drop Cookie Dough

- Scoop and freeze on cookie sheet
- Balls of dough can be placed in an airtight container and stored in freezer for up to 6 weeks
- Bake from frozen: drop temperature by 25°F and add a few minutes on baking time
- Or can bring dough to cool room temperature and bake as recipes states

Control Chocolate Chip Cookie Recipe

Ingredient	Amount (grams)	Amount (volume)	Baker's %
All-purpose flour	317	2 ½ cups	100
Baking soda		1 tsp.	
Baking powder		1 tsp.	
Salt		1 tsp.	
Unsalted butter, cool room temperature	226	1 cup	71.3
Granulated sugar	150	¾ cup	47.3
Brown sugar	150	¾ cup	47.3
Eggs, cool room temperature		2	
Vanilla extract		1 tsp.	
Semi-sweet chocolate chips	255	1 ½ cups	80.4

Cookie Base Recipe

Ingredient	Amount (grams)	Amount (volume)	Baker's %
All-purpose flour	191	1 ½ cups	100
Baking soda		½ tsp.	
Baking powder		½ tsp.	
Salt		½ tsp.	
Unsalted butter, cool room temperature	113	½ cup	59.2%
Granulated sugar	150	¾ cup	78.5%
Egg, cool room temperature		1	
Extract		½ tsp.	
Mix-in		1 cup	

Chewy Cookie

- Use more brown sugar – very hygroscopic (takes in and retains moisture)
  - Keep total amount of sugar the same
  - Dark brown sugar instead of light brown sugar (even more moisture and flavor)
- Add an egg yolk along with the other egg(s) – protein, fat, moisture
  - Can add 1 Tbsp. of flour if you still want a thick cookie
- Substitute some or all of the all-purpose flour with bread flour – depending on how much chew you want
  - Bread = higher protein, so more gluten formation; also absorbs more moisture
- Chill the dough 24-72 hours – allows for absorption
  - Also adds flavor!

Chewy Cookie

- Use melted butter
  - Can add 1-2 T. of flour to reduce spreading and greasiness
  - Butter is 20% water, so melting it helps butter hydrate the flour and form gluten
- Add 1 T. corn syrup
  - After creaming butter and sugars
  - Prevents sugar from crystallizing

Soft Cookies

- Use more brown sugar – hygroscopic
  - Keep total amount of sugar the same
- Add cornstarch – thickening agent, aids in lift and height, dilutes protein
  - Add 1-2 tsp. with the dry ingredients
- Use pastry or cake flour – less gluten provides softness, finer texture
  - Substitute for up to half of the all-purpose flour
  - Cookies will also spread relatively thin so can add slightly more flour or chill the dough balls before baking to prevent too much spreading

Soft Cookies

- Add cream cheese – adds richness and flavor, tenderizes
  - 2-4 oz of room temperature (full fat) cream cheese with butter and sugar, depending on yield of the recipe
  - May need to add 1-4 T. flour to compensate for the added moisture
- Bake at 325°F – less caramelized texture and flavor

Cakey Cookies

- Add cornstarch – thickening agent so adds lift and height, dilutes protein
  - Add 1-2 tsp. with dry ingredients
- Add liquid sweetener – hygroscopic so complete with protein for moisture in dough, slowing gluten development
  - Replace 15-50% of sugar in recipe with liquid sweetener; don't want too much because don't have a crystalline structure to hold air when beaten with butter
  - Will need to add more flour (2 T. to ½ cup) to compensate extra moisture

Cakey Cookies

- Add an egg white to the other eggs in the recipe
  - Adds more water content to dough that then evaporates, creating a taller, lighter
- Use pastry or cake flour – less protein so less gluten development
  - substitute up to half of the all-purpose flour
  - Cookies will spread more so can add more flour or chill your dough

Thick and Tall Cookies

- Chill the dough – no more than 72 hours
  - Ensure hydration of dry ingredients to make a firmer dough
  - Will also marinate the flavors
  - Could also refrigerate the balls of dough until chilled, about 30min to an hour before baking
- Scoop tall mounds of dough – take longer to spread in the oven
- Add extra flour – removes moisture in dough
  - 1-4T. Of extra flour
- Use shortening – higher melting point than butter and no water content (takes longer to melt and moistens less)
  - Replace half of the butter with shortening
- Add cornstarch – thickening agent
  - Add 1-2 tsp.

Thin and Crispy Cookie

- Use more granulated sugar – much less hygroscopic than brown sugar and liquid sweeteners so increased spread and crispness
  - Substitute up to ¾ of the total sugar in the recipe or just add additional granulated sugar beyond total amount
  - Be careful to substitute all of the sugar because if there's baking soda in the recipe, it will need acid from brown sugar or other ingredients to activate
- Add milk – increases moisture which gives more spread
  - 1-2 T. with the eggs and vanilla
- Use less flour – increases moisture content of dough
  - Remove up to 3 T.

Thin and Crispy Cookie

- Use a hot, greased baking pan – more grease and heat allows for more spread
  - Place baking pan in oven for 5 minutes or until hot, then spray with nonstick spray
- Use melted butter – gives warmer dough and becomes more browned and crispy
  - Melt butter before vigorously stirring in sugar
  - Let mixture cool before continuing with the recipe as it says
- Flatten the dough – more likely to spread and flatten during baking
  - Can use palm of your hand or bottom of a measuring cup

Conduct Test Kitchen Cookie Science,

A Bakers Dozen Lab 7

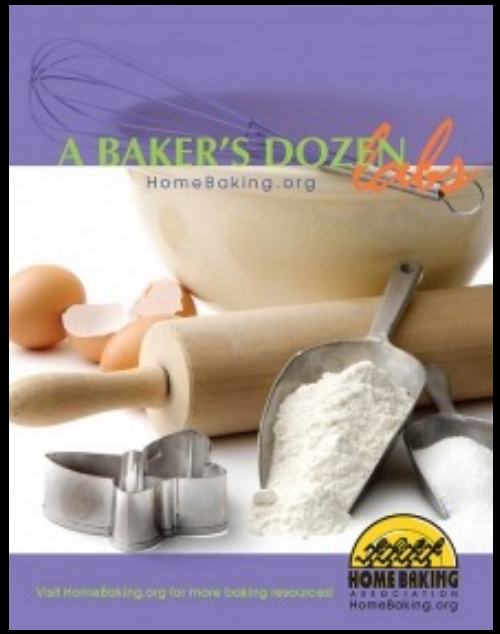
- Flour substitutions
- Sugar substitutions
- Fats
- Leavening
- Eggs
- Milk
- Temperatures

https://food.fnr.sndimg.com/content/dam/images/food/fullset/2015/5/11/0/FNK_chocolate-chip-cookie-guide-full-group-02_s4x3.jpg.rend.hgtvcom.616.462.suffix/1431360888017.jpeg

Cookie Science Lab Teaching Ideas

- Does each group pick an ingredient variation to try and then all students try each one?
- Does each group want to create their perfect cookie? Turn it into a competition!
- Have students create a 30 second commercial to the class to explain/promote their cookie variation and then taste test.
- Have it as a schoolwide taste test or invite judges to come in to see who has the best cookie.

Home Baking Association: Lab Manual



- Cookie Science Substitution
- Lab 7 – Sweet! Baking Sugars

Recipe Website Sources: Weight

HANDLE THE HEAT

BAKER BY NATURE

SALLY'S BAKING ADDICTION

- BakerBettie.com
- BiggerBolderBaking.com
- Home Baking Association Labs, HomeBaking.org
- KingArthurBaking.com

Competitions, Awards

HOME BAKING
ASSOCIATION
HomeBaking.org

Thank you!

Sharon Davis, hbadavis@gmail.com

Mozzarella Mash
Carla Shaer, Illinois

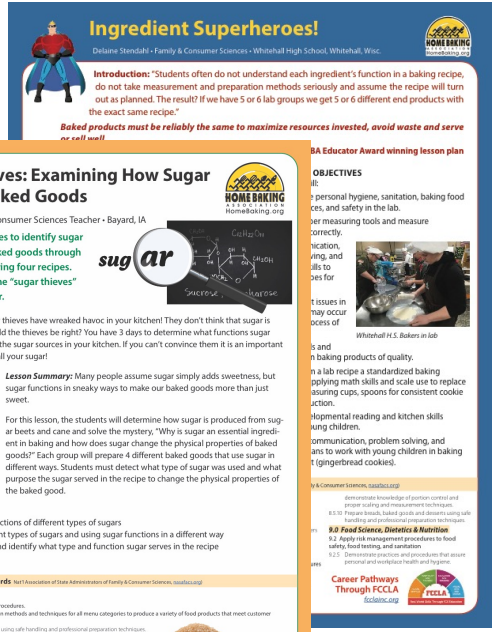
The Power Of Eggs
Ingredient Super Heroes
Delaine Stendahl, FCS, Whitehall H.S., WI

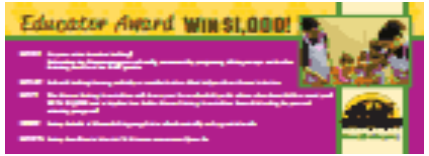
The Muffin Man and the Healthy Kids Act
Katie Brouwer, FCS, H.S., Story City, IA

Baking Clubs @ Work, Cheryl Doyle & Louann Moos, Pennbrook M.S., PA

Pastry Pizzazz
Marla Prusa, FCS, H.S., Howells, NE

Sugar Detectives!
Elizabeth Hagan, FCS, Bayard, IA





Promote, enter on-line, May 31, 2023

FREE Downloadables,
www.HomeBaking.org

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