

How the cookie crumbles

Learning objective

- Develop an understanding of the functional roles of ingredients in bakery technology and how this impacts product quality and texture

Group activity

Create a variety of cookie recipes to demonstrate the role of individual ingredients in food preparation, highlighting how small adjustments in ingredient composition can impact the quality, texture, and overall characteristics of the final products.

The Science

Fat

Fat plays a crucial role in the texture, flavour, and structural characteristics of cookies. Adjusting the amount or type of fat in a cookie recipe can lead to notable changes due to its interaction with other ingredients during mixing, baking, and cooling processes.

Adding Fat

Increasing the fat content in a cookie recipe generally results in a richer, softer, and more tender texture. Fat acts as a tenderiser by coating gluten-forming proteins (gliadin and glutenin) in the flour, reducing their ability to bond and form a strong gluten network. This weakened gluten structure limits the cookie's ability to stretch and become chewy, leading instead to a more delicate crumb. Furthermore, fats like butter and oils melt during baking, creating small air pockets in the dough. This contributes to the characteristic crisp edges and soft centres of many high-fat cookies.

Fats also influence the spread of cookies in the oven. More fat increases spread as it melts, which can result in a thinner, crispier cookie. Additionally, the type of fat used affects flavour and mouthfeel; for instance, butter imparts a rich, creamy taste due to its water and milk solids, while shortening or oils create a more neutral base. The presence of fat also enhances the perception of flavours by dissolving certain aroma compounds that are more noticeable in a fat-rich environment.

Reducing or Removing Fat

Reducing or omitting fat in a cookie recipe has a significant impact on texture and structure. With less fat to coat the proteins in flour, gluten development increases,

leading to a tougher and chewier cookie. Reduced-fat cookies often spread less, yielding a thicker, more cake-like texture. The absence of fat also diminishes the richness and mouthfeel that fat typically provides, often making cookies taste drier or starchier.

When fat is significantly reduced or removed, other ingredients, like sugar or liquid, may need to be adjusted to retain some tenderness and moisture. Sugar, for example, can partially compensate for fat by absorbing moisture and providing some tenderness through its interference with gluten formation. Alternatively, fat substitutes, such as applesauce or yoghurt, can be used to maintain moisture but will lack the same richness, flavour, and crispness that traditional fats offer.

Flour

The type of flour used in cookie recipes—particularly its protein content—significantly influences the texture, spread, and structure of the final product. Switching from low-protein flour, such as cake flour, to high-protein flour, such as bread flour, or opting for a gluten-free alternative changes how the dough develops and behaves during baking.

High-Protein Flour

High-protein flour, such as bread flour, contains more gluten-forming proteins (gliadin and glutenin) than lower-protein flour. These proteins interact with water and kneading to create a strong, elastic gluten network, which can lead to a denser, chewier cookie. When using high-protein flour, cookies typically spread less in the oven, as the stronger gluten structure restricts dough expansion, resulting in thicker, more structured cookies. This added density makes high-protein flour a common choice for baked goods that need elasticity, such as bread, but it may yield a less tender cookie than one made with low-protein flour.

Cookies made with high-protein flour are more resilient and have a chewy, hearty texture. This is due to the increased gluten, which provides a more durable, cohesive structure. However, the added protein can also make the cookies drier and tougher if overmixed, as too much gluten formation creates a firm texture. Balancing other ingredients, such as sugar or fat, can help offset some of the additional chewiness and prevent cookies from becoming too dense.

Low-Protein Flour

Low-protein flours, such as cake or pastry flour, contain less gluten-forming proteins, resulting in a weaker gluten network that produces a more delicate, tender cookie. This flour type allows for more spread during baking, leading to a thinner, crispier, and more tender cookie that melts in the mouth. With less protein to hold the structure, cookies made with low-protein flour tend to be soft and light, making it ideal for creating cookies with a delicate crumb.

Gluten-Free Flour

Switching to gluten-free flour introduces different structural dynamics to the cookie-making process. Gluten-free flours are made from alternative grains (such as rice, almond, or coconut) or starchy roots (such as tapioca or potato) and lack the gluten-forming proteins that contribute elasticity and cohesiveness to the dough. As a result, gluten-free cookies may have a crumblier, more fragile texture because they lack the natural binding properties of gluten.

To mimic the effects of gluten, gluten-free recipes often require additional ingredients, such as xanthan gum or guar gum, to provide structure and prevent excessive spreading. Without these additives, gluten-free cookies can flatten or spread too much, creating thin, brittle edges with a tender but potentially crumbly interior. The mouthfeel of gluten-free cookies may also differ, as these flours absorb moisture differently and sometimes contribute unique flavours and textures to the final product.

Eggs

Eggs play a fundamental role in cookie recipes, contributing to structure, moisture, and colour, while milk provides different proteins and moisture content that can affect the final product in unique ways. Replacing eggs with milk in cookies changes the overall texture, spread, and binding capacity of the dough, as well as the appearance and flavour of the cookies.

Replacing Eggs with Milk: Impact on Structure and Texture

Eggs provide a combination of proteins and emulsifying properties that contribute to the structure and stability of cookies. The proteins in eggs coagulate when heated, helping cookies set and hold their shape. Additionally, the lecithin in egg yolks acts as an emulsifier, binding fat and water-based ingredients to create a smooth, stable dough. Replacing eggs with milk, which contains fewer proteins and lacks lecithin, results in a softer, more fragile structure. Without the same binding properties, cookies made with milk instead of eggs may spread more and be less cohesive, producing a flatter and potentially more crumbly texture.



Easy chocolate chip cookies (Recipe 1)

Ingredients

50 g baking spread, softened

35 g light brown sugar

35 g golden caster sugar

1/2 medium egg

1/2 tsp vanilla extract

90 g plain flour

1/4 tsp bicarbonate of soda

75 g dark chocolate, cut into chunks

Method

- **STEP 1**

Heat oven to 180C/160C fan/gas 4 and line 1 baking sheet with parchment. Cream the butter and sugars together until very light and fluffy, then beat in the egg and vanilla. Once combined, stir in the flour, bicarb and chocolate.

- **STEP 2**

Scoop 5 large tbsps of the mixture onto the trays, leaving enough space between each to allow for spreading. Bake for 10-12 mins or until firm at the edges but still soft in the middle – they will harden a little as they cool. Leave to cool on the tray for a few mins before eating warm, or transfer to a wire rack to cool completely.

Taken and modified from BBC Good Food 2024.

Easy chocolate chip cookies (Recipe 2)

Ingredients

120 g baking spread, softened

35 g light brown sugar

35 g golden caster sugar

1/2 medium egg

1/2 tsp vanilla extract

90 g plain flour

1/4 tsp bicarbonate of soda

75 g dark chocolate, cut into chunks

Method

- **STEP 1**

Heat oven to 180C/160C fan/gas 4 and line 1 baking sheet with parchment. Cream the butter and sugars together until very light and fluffy, then beat in the egg and vanilla. Once combined, stir in the flour, bicarb and chocolate.

- **STEP 2**

Scoop 5 large tbsps of the mixture onto the trays, leaving enough space between each to allow for spreading. Bake for 10-12 mins or until firm at the edges but still soft in the middle – they will harden a little as they cool. Leave to cool on the tray for a few mins before eating warm, or transfer to a wire rack to cool completely.

Taken and modified from BBC Good Food 2024.

Easy chocolate chip cookies (Recipe 3)

Ingredients

60 g butter, softened
35 g light brown sugar
35 g golden caster sugar
1/2 medium egg
1/2 tsp vanilla extract
90 g plain flour
1/4 tsp bicarbonate of soda
75 g dark chocolate, cut into chunks

Method

- **STEP 1**

Heat oven to 180C/160C fan/gas 4 and line 1 baking sheet with parchment. Cream the butter and sugars together until very light and fluffy, then beat in the egg and vanilla. Once combined, stir in the flour, bicarb and chocolate.

- **STEP 2**

Scoop 5 large tbsps of the mixture onto the trays, leaving enough space between each to allow for spreading. Bake for 10-12 mins or until firm at the edges but still soft in the middle – they will harden a little as they cool. Leave to cool on the tray for a few mins before eating warm, or transfer to a wire rack to cool completely.

Taken and modified from BBC Good Food 2024.

Easy chocolate chip cookies (Recipe 4)

Ingredients

20 g baking spread, softened

35 g light brown sugar

35 g golden caster sugar

1/2 medium egg

1/2 tsp vanilla extract

90 g plain flour

1/4 tsp bicarbonate of soda

75 g dark chocolate, cut into chunks

Method

- **STEP 1**

Heat oven to 180C/160C fan/gas 4 and line 1 baking sheet with parchment. Cream the butter and sugars together until very light and fluffy, then beat in the egg and vanilla. Once combined, stir in the flour, bicarb and chocolate.

- **STEP 2**

Scoop 5 large tbsps of the mixture onto the trays, leaving enough space between each to allow for spreading. Bake for 10-12 mins or until firm at the edges but still soft in the middle – they will harden a little as they cool. Leave to cool on the tray for a few mins before eating warm, or transfer to a wire rack to cool completely.

Taken and modified from BBC Good Food 2024.

Easy chocolate chip cookies (Recipe 5)

Ingredients

50 g baking spread, softened

7.5 g Canderell

1/2 medium egg

1/2 tsp vanilla extract

90 g plain flour

1/4 tsp bicarbonate of soda

75 g dark chocolate, cut into chunks

Method

- **STEP 1**

Heat oven to 180C/160C fan/gas 4 and line 1 baking sheet with parchment. Cream the butter and sugars together until very light and fluffy, then beat in the egg and vanilla. Once combined, stir in the flour, bicarb and chocolate.

- **STEP 2**

Scoop 5 large tbsps of the mixture onto the trays, leaving enough space between each to allow for spreading. Bake for 10-12 mins or until firm at the edges but still soft in the middle – they will harden a little as they cool. Leave to cool on the tray for a few mins before eating warm, or transfer to a wire rack to cool completely.

Taken and modified from BBC Good Food 2024.

Easy chocolate chip cookies (Recipe 6)

Ingredients

50 g baking spread, softened

35 g light brown sugar

35 g golden caster sugar

1/2 medium egg

1/2 tsp vanilla extract

90 g bread flour

1/4 tsp bicarbonate of soda

75 g dark chocolate, cut into chunks

Method

- **STEP 1**

Heat oven to 180C/160C fan/gas 4 and line 1 baking sheet with parchment. Cream the butter and sugars together until very light and fluffy, then beat in the egg and vanilla. Once combined, stir in the flour, bicarb and chocolate.

- **STEP 2**

Scoop 5 large tbsps of the mixture onto the trays, leaving enough space between each to allow for spreading. Bake for 10-12 mins or until firm at the edges but still soft in the middle – they will harden a little as they cool. Leave to cool on the tray for a few mins before eating warm, or transfer to a wire rack to cool completely.

Taken and modified from BBC Good Food 2024.

Easy chocolate chip cookies (Recipe 7)

Ingredients

50 g baking spread, softened

35 g light brown sugar

35 g golden caster sugar

1/2 medium egg

1/2 tsp vanilla extract

90 g gluten-free flour

1/4 tsp bicarbonate of soda

75 g dark chocolate, cut into chunks

Method

- **STEP 1**

Heat oven to 180C/160C fan/gas 4 and line 1 baking sheet with parchment. Cream the butter and sugars together until very light and fluffy, then beat in the egg and vanilla. Once combined, stir in the flour, bicarb and chocolate.

- **STEP 2**

Scoop 5 large tbsps of the mixture onto the trays, leaving enough space between each to allow for spreading. Bake for 10-12 mins or until firm at the edges but still soft in the middle – they will harden a little as they cool. Leave to cool on the tray for a few mins before eating warm, or transfer to a wire rack to cool completely.

Taken and modified from BBC Good Food 2024.

Easy chocolate chip cookies (Recipe 8)

Ingredients

50 g baking spread, softened

35 g light brown sugar

35 g golden caster sugar

30 g milk

1/2 tsp vanilla extract

90 g plain flour

1/4 tsp bicarbonate of soda

75 g dark chocolate, cut into chunks

Method

- **STEP 1**

Heat oven to 180C/160C fan/gas 4 and line 1 baking sheet with parchment. Cream the butter and sugars together until very light and fluffy, then beat in the milk and vanilla. Once combined, stir in the flour, bicarb and chocolate.

- **STEP 2**

Scoop 5 large tbsps of the mixture onto the trays, leaving enough space between each to allow for spreading. Bake for 10-12 mins or until firm at the edges but still soft in the middle – they will harden a little as they cool. Leave to cool on the tray for a few mins before eating warm, or transfer to a wire rack to cool completely.

Taken and modified from BBC Good Food 2024.