

STEM in Food Science in Technology and Living

Flours and Flour Mixtures

Raising agent

What is yeast?

- Yeast is very small single-celled microorganism
- It can break down sugars for energy, this process is called fermentation
- When energy is released, yeast can survive, grow, and reproduce
- Human beings have been using yeast in making breads for thousands of years, but it was until mid-1800s when scientist, Louis Pasteur proved that living yeast was necessary for fermentation

Raising agent

How does yeast produce carbon dioxide?

- Yeast can break down sugars into smaller simpler molecules
- Yeast lacks amylase and cannot break down starch into sugar
- Sometimes, amylase is added as an additive in bread, especially in lean dough where the ingredients are just flour, water, salt and yeast
- In the breakdown of sugars to carbon dioxide, many steps are involved, the process is called glycolysis

Raising agent

Glycolysis



- Alcohol evaporates to a gas and expands during baking
- Therefore, alcohol also becomes an important leavening gas in yeast-raised baked goods

Raising agent

Factors affecting yeast fermentation

- Temperature of dough
 - yeast is dormant at 0-1°C and begins to be quite active starting at about 10°C.
 - at about 50°C, fermentation slows down because yeast cells begin to die, the optimum fermentation is at 25-28°C
- Amount of salt
 - salt retards yeast and bacterial fermentation, therefore the higher the amount of salt, the slower the fermentation rate
- Amount of sugar
 - sugar favours fermentation, but excess amount of sugar slows down fermentation

Raising agent



Bread with different amounts of salt:

- low salt (0%, 0g) (left),
- medium salt (1%, 5g) (middle)
- high salt (2%, 10g) (right)

- 1% salt is the control.
- Excessive salt will lower the volume of baked products.



Raising agent



Bread dough with different amounts of sugar:

- low sugar (0%) (left),
- medium sugar (5%) (middle)
- high sugar (> 15%) (right)

- 5% sugar is the control.
- Sugar will affect the volume of bread dough.



Raising agent

Factors affecting yeast fermentation (cont'd)

- Type of sugar
 - sucrose, glucose, and fructose favour fermentation
 - yeast with maltose ferments slowly
 - yeast with lactose does not ferment at all
- The pH of dough
 - the optimum pH for yeast fermentation is 4 to 6, rate of fermentation slows down beyond this range
- Presence of antimicrobial agents
 - calcium propionate as a preservative to prevent mould growth, will slow down or stop the growth of yeast at the same time

Raising agent

Chemical leavening agents

- Chemical leaveners break down in the presence of moisture or heat, and give off gases
- Chemical leavener:
 - baking soda
 - baking powder (baking soda combined with one or more acids)
 - baking ammonia, used in European and Chinese cuisine

Raising agent

Baking soda

- Also known as sodium bicarbonate or bicarbonate of soda
- Gives off gas in the presence of moisture and heat
- However, a great amount of baking soda is needed to produce sufficient carbon dioxide for leavening
- High amount of baking soda produce yellow or green discolouration and a strong salty, chemical bite from sodium carbonate residue
- When baking soda is used for leavening, it is used with acid

Raising agent

Acid-base reaction

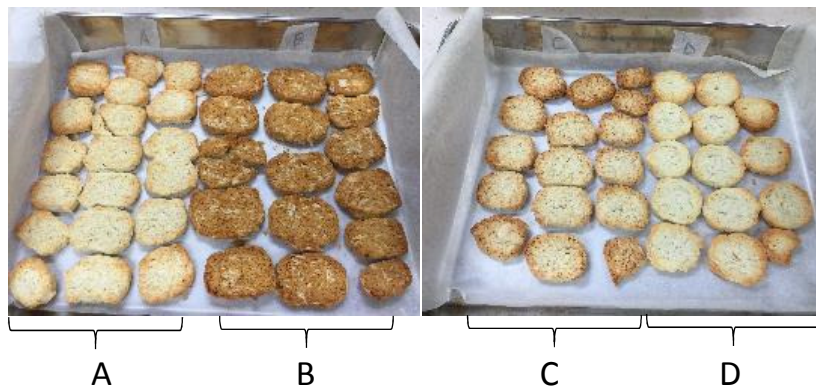


- Acids react with baking soda in the presence of moisture, carbon dioxide is released as leavening gas
- When a lot of baking soda is added to baked goods, both the unreacted baking soda and the remaining salt residue contribute to off-flavours, and in some circumstances, more browning due to more Maillard reactions

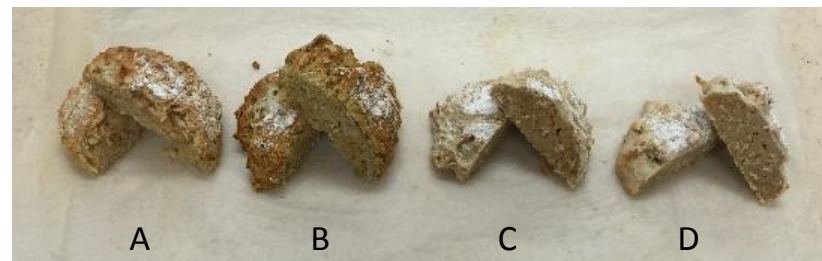
Raising agent

From below clockwise: almond cookies, soda bread, and muffins.

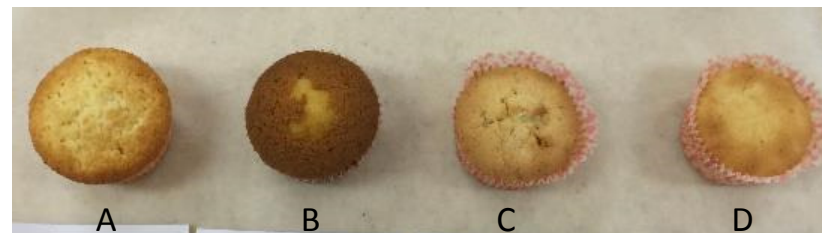
Products made with (A) baking powder, (B) baking soda, (C) yeast, and (D) no raising agent (from left to right).



Baking soda in B causes more browning reaction.



Yoghurt as an acidic ingredient is added to soda bread to react with baking soda.



D did not rise because no raising agent is added.

Raising agent

Acid-base reaction (cont'd)

- Acidic ingredients commonly used with baking soda:
 - buttermilk
 - yoghurt
 - sour cream
 - fruits and fruit juices
 - vinegar
 - most syrups, including molasses and honey
 - brown sugar
 - unsweetened chocolate and natural cocoa

Raising agent

Baking powder

- All baking powders contain:
 - baking soda
 - one or more acids (in the form of acid salts)
 - starch or filler, to absorb moisture
- Acid salts release acid once they are dissolved in water
 - e.g. cream of tartar, also called potassium acid tartrate, is an acid salt
 - when cream of tartar dissolves in batter or dough, tartaric acid is released
 - tartaric acid reacts with baking soda to release carbon dioxide

Sugar

Functions of sugar

Sugar does not only contribute to sweetness, it also influences the volume, moistness, tenderness, colour, appearance, and caloric content of baked products

- Increases the volume of cakes and cookies
 - incorporation of air into the fat during creaming (especially with granulated sugars)
- Contributes to the volume by providing food for the yeast
 - the more the food for yeast, the more fermentation, hence the more carbon dioxide produced

Sugar

Functions of sugar (cont'd)

- Increases the volume of the baked product and contributes to a finer and more even texture
 - sugar raises the temperature at which gelatinisation and coagulation occur, starch granules have more time to swell before they gelatinise, and thus giving the gluten more time to stretch
- Increases moistness and tenderness and also helps delay staling
 - sugar has water-retaining nature, this will improve the shelf life of the baked product
- Contributes to the tenderness
 - crust of the baked product becomes softer as sugar attracts moisture

Sugar

Functions of sugar (cont'd)

- Helps brown the crust of the baked product
 - caramelisation and Maillard reaction take place with the presence of sugar

Sugar

0 g

16 g

32 g

48 g

64 g



Sponge cake with varied amounts of sugar.

32g sugar is the standard amount for making sponge cake in this recipe.



Sugar

Too much sugar

- The baked product may fall
- A lower volume
- Coarse texture
- Gummy texture
- Excessively browned crust
- Too sweet

Too little sugar

- Dryness
- Reduced browning
- Lower volume
- Less tenderness

Salt

- Salt is a compound commonly used in food preservation. It provides flavour to foods.
- Types of salt include:
 - fortified table salt (iodine is usually added in salt fortification)
 - unrefined sea salt
 - light salt (potassium chloride) for reducing sodium levels
 - gourmet salt (e.g. truffle salt)

Salt

Functions of salt

A small amount of salt is added to flour mixtures for flavouring, for producing a firmer dough, for improving the volume, texture, and evenness of bread crumb structure, and to prolong shelf life

- Adds flavour to the baked product
 - the baked product made without salt tend to be bland
- Plays an important role in forming the dough
 - salt adjusts the solubility and swelling capacity of the gluten, making the dough more pliable, and aiding gluten formation

Salt

Functions of salt (cont'd)

- In the production of yeast bread, salt helps control yeast growth
 - without salt, fermentation would be too rapid and result in a sticky dough
 - too much salt would inhibit yeast activity, reducing the amount of carbon dioxide gas produced and decreasing the volume of the loaf

Salt

Salt influences dough firmness.
Bread dough with varied amounts
of salt: 0g, 5g, and 10g, (from left to
right).

5g salt is the standard amount for
making bread loaf in this recipe.



Salt

Too much salt

- A firm dough
- Low volume
- Dense texture
- Too salty

Too little salt

- A flowing and sticky dough
- Low volume
- Uneven texture
- Lack of colour
- Bland in taste

Eggs

- Eggs are added to flour mixtures to create different results
- Important constituents of eggs:
 - Egg white – can be whipped into foam and trap air
 - supplies protein and B vitamins
 - Egg yolk – acts as emulsifiers, adds flavour, nutrients, and colour
 - supplies fat-soluble vitamins (A, D, E, and K), cholesterol and fat



Whipping egg white

Eggs

Functions of eggs

Eggs are added to enhance structural integrity, contribute to leavening, colour, flavour and nutritive value

- Enhance structural integrity
 - coagulation of egg proteins during baking increases firmness
- Contribute to leavening
 - air is incorporated when beating eggs
 - during baking, trapped air expands
 - liquid in the egg turns to steam when heated, product expands in volume

Eggs

Functions of eggs (cont'd)

- Egg yolks add flavour, nutrients and colour
 - more yellow crumb and browner crust can be formed
- Delay staling
 - emulsifier and fat in egg prevent recrystallisation of starch, hence delay staling
- Improve appearance of baked product
 - a shiny glaze is resulted from egg-wash

Eggs

Buns that are egg-washed with egg white, whole egg, and egg yolk (from left to right); effects are pale, shiny and dark respectively.



Eggs

Too many eggs

- Dense texture
- Tough and rubbery texture in baked products

Too little egg

- Insufficient volume
- Poor structural strength, colour, flavour and nutritive value

Eggs

Egg influences structure of pound cake.
Pound cake with varied amounts of egg: 50g, 100g, and 150g, (from left to right).

100g egg is the standard amount for making pound cake in this recipe.



Related Food Tests

Food Test Number	Food Test
Food Test 9	Observe the reaction of biological and chemical raising agents in water
Food Test 10	Functions of different raising agents in muffins
Food Test 11	Effects on sponge cake with different amounts of sugar
Food Test 12	Effects on bread dough with different amounts of salt
Food Test 13	Effects on pound cake with different amounts of egg