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Kitchen Curiosities

Conceptual introduction

The teaching unit 'Kitchen Curiosities' plays in two different settings: the school yard (→ page 38) and the kitchen itself (→ page 43). If you want to know what can be found in a kitchen you can head for the vocabulary corner. [1]

In the story, the children are introduced to the origin of the Hindu-Arabic numeral system. The Hindu-Arabic numerals are compared to Roman and ancient Egyptian numerals.

The children also learn about different kinds of bread and baked goods:

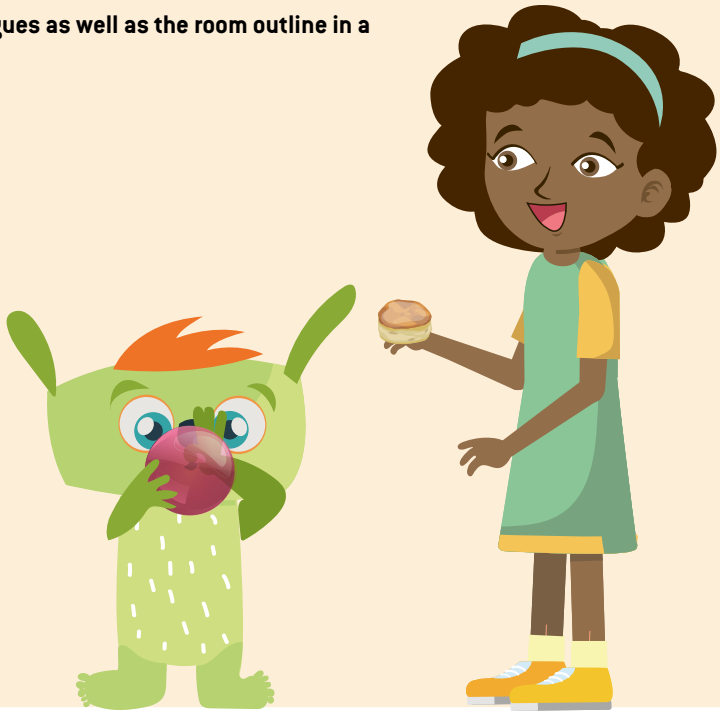
- chapatis from India, Afghanistan and East Africa
- naan taftoon from Iran, Pakistan and Northern India
- pita bread from Syria, Lebanon and Greece
- focaccia from Italy
- scones from Great Britain

Except for the chapati dough, all these doughs contain yeast or baking powder: dry yeast in naan taftoon and pita bread, fresh yeast in focaccia and baking powder in scones.

The children are asked to decipher bread recipes in Arabic, Hindi and Persian. This puts children from countries with Latin writing in a situation in which they are confronted with a text they cannot read – a common situation for children who are not yet familiar with Latin writing.

The kitchen is a perfect place to experiment with yeast and dough. In the first experiment (→ page 48), the children investigate the effects of dry yeast and learn how to handle experiments with several independent parameters. The second experiment (→ page 50) is about how the different doughs float or sink. In the third experiment (→ page 52), cabbage juice, lemon juice and baking soda are used to change the colour of the dough.

- **You can find the plain texts and dialogues as well as the room outline in a printer-friendly version online.** [1]



Lilu and Alina at school

SUMMARY

The children discover various kinds of breads eaten in different countries of the world. They learn about the origin of our numerals and make simple calculations with Roman and ancient Egyptian hieroglyphic numerals. The children examine different kinds of grains and identify the germ and the bran. Also, they can talk about the availability of drinking water.

LEVEL

difficult

DURATION

3 × 45–60 minutes

VOCABULARY

names of flatbreads, bread ingredients, countries

MATERIAL

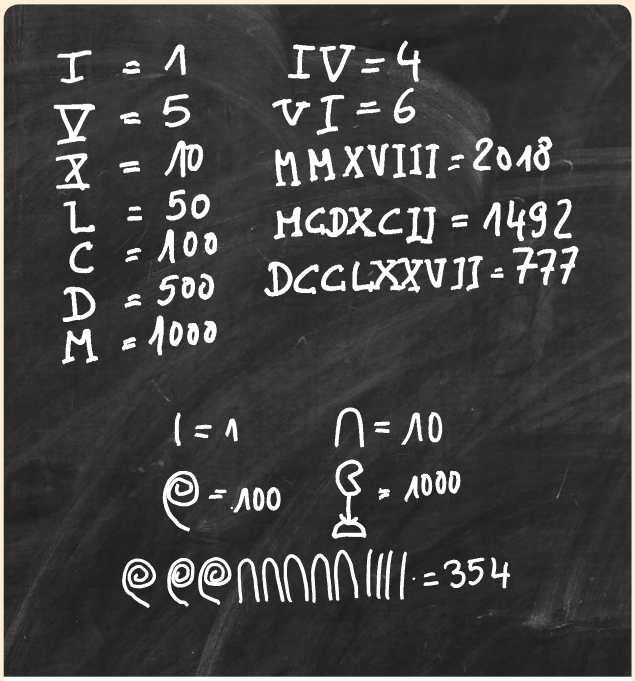
- a globe or a world map
- worksheet A – Roman and ancient Egyptian hieroglyphic numerals [1]
- different kinds of grains (e.g. wheat, oat, rye)

The math lesson is over and the children of class 4 are rushing out into the schoolyard holding their break time snacks. Alina, Malaika, Tom, Jamuna, Asal and Paolo meet at their favourite place: the two benches under the plane tree. The six children are very close friends. The teachers call them 'United Nations': Alina is from London (United Kingdom), Malaika from Aleppo (Syria), Tom from Berlin (Germany), Jamuna from Jaipur (India), Asal from Isfahan (Iran) and Paolo from Genoa (Italy). Malaika came to London just a few months ago. She and her family had to flee from the Syrian civil war. Her English is already very good.

Stop and spot!

Find the towns and countries of origin of the children's families on a globe or a world map.

Alina, Malaika, Tom, Jamuna, Asal and Paolo are talking excitedly about their math lesson: Today they have learnt about the Hindu-Arabic numerals. The ten numbers they have to juggle with each day – 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 – originally came from India. They have compared these numerals to the Roman numerals and to the ancient Egyptian hieroglyphic numerals.



Roman and ancient Egyptian hieroglyphic numerals

Tom: Jamuna, it's great that your ancestors invented our numbers – just imagine if we had to deal with Roman numerals or the ancient Egyptian numerals.

Jamuna: Oh yes, I totally agree – Hindu-Arabic numerals are so much easier to deal with.

Background information: The Hindu-Arabic numeral system

Indian mathematicians invented our decimal number system, including the digit zero

0, 1, 2, 3, 4, 5, 6, 7, 8 and 9

around the year 500 – approximately 1,500 years ago. Later, in the 7th and 8th century, the Indian numeral system spread to several Arabic countries before it moved on to Europe in the 9th century, where it gradually replaced the Roman numerals.

Stop and sum up!

For the teacher: Introduce Roman numerals and how they are 'assembled' as well as ancient Egyptian hieroglyphic numerals.

Asal: I like the ancient Egyptian numerals. Look at, for example, *777*. Such an easy number. With hieroglyphs, it's quite long to write, but at least you don't have to think much. Let's try to add up *777* and 333.

Paolo: That sounds great – I like the Roman numerals and I'll try to work it out too.

Stop and practice!

Solve the exercises in worksheet A – Roman and ancient Egyptian hieroglyphic numerals.[1] You can also invent your own calculations and solve them.

Lilu suddenly appears and jumps on the backrest of one of the benches.

Lilu: I was hiding in the tree and listening in on your conversation. Have you ever thought what it would be like if we had no

numbers at all? *Lilu sings:* I have a head, and a few arms, and a lot of fingers, and the same amount of toes. I have more ears than noses. *Lilu and the children are laughing their heads off.*

The children open their lunch boxes and start to eat.

Alina to Asal: You always have these pancakes in your lunch box – they look so yummy. They look so much tastier than my sloppy toast sandwich.

Asal to Alina: It's not a pancake, it's a flatbread. We call it naan taftoon or taftoon bread.

Paolo: Funny name! My bread is called focaccia – it's not as flat as yours, and there are holes in the dough, look. It has lots of olive oil in and on it, and rosemary. Focaccia is made with fresh yeast.

Lilu steals a piece of Paolo's focaccia and quickly stuffs it into his mouth.

Lilu: Hmmm, delicious … olive oil and rosemary.

Asal: My taftoon bread is also made with yeast – with dry yeast. It looks like light brown grains, a little bit like coarse sand. It comes in little packets.

Malaika: Pita bread is also made with yeast, yeast from little packets. When my father makes pita bread, I help him.

Recipe for focaccia

For the dough:

- fresh yeast (40 g)
- 1 tsp. of sugar
- 200 ml of lukewarm water
- 400 g of wheat flour
- 100 g of semolina
- 100 ml of olive oil

For the top of the bread:

- 1 tbsp. of coarse sea salt
- 2 tbsp. of fresh rosemary

Mix all ingredients to a dough and let rise in a warm place for 30–40 minutes. Place the dough on a baking tray and flatten it out. Sprinkle coarse sea salt and fresh rosemary over dough. Bake for 25–30 minutes in a preheated oven (200 °C).

Preparation time (without resting and baking): 20–30 min

Stop and jot down!

Look up the meaning of the words that are new to you. Write them down in your exercise book together with an explanation. You can also add a drawing or bring the item (e.g. rosemary, yeast) into class.

For the teacher: The children could work in groups, each group looking up two or three words and then explaining these words to their classmates.

Alina: Hey Jamuna, your bread looks like a pancake too. Only my toast and Tom's bread look different. Tom, is that the great wholewheat bread that your father bakes?

Tom: Yes, it is. I like it, and my father keeps on saying how healthy it is.

Stop and jot down!
Make a list of the flatbreads introduced in this story. Look up on the Internet which countries they are eaten in and how they are eaten. If you know of more types of bread, you could add them to the list. You can also make a presentation for your classmates.

Lilu interrupts him.

Lilu *talking like a professor:* Wholewheat is much healthier. Whole grains still have their shell, also called bran, and the germ. Bran and germ contain fibres, vitamins, minerals and oil. I eat a lot of wholewheat bread and look how healthy I am.

Stop and draw!
Look at a plain wheat grain and a wholewheat grain with a magnifying glass. Identify the bran and the germ. Make a drawing with the parts labelled in your exercise book.

Stop and sort!
The children and/or the teacher bring several different kinds of cereal grains into class: wheat, oat, rye, barley, spelt, maize, rice, millet, etc. Other grains look like cereal grains, but they are not. There are pseudo-cereal grains like amaranth, quinoa, chia and buckwheat, or seeds like sunflower, flax, hemp and poppy seeds, or pulses like beans, chickpeas, lentils, peanuts, etc.

Task: Sort out the grains, seeds and pulses you and your teacher have brought into class. Look for information on the Internet.

For more information on beans, please go to the living room (→ page 56).

Lilu does a cartwheel on the backrest, jumps onto the backrest of the second bench, jumps into the tree and hangs upside down from a branch of the tree.

Alina: Oh Lilu, we know that you are the greatest, the most beautiful, the most intelligent creature on earth.

Tom: I would so much like to try all your breads. They look really interesting. Maybe we should meet at the weekend and have a big bread party?

Lilu: Great idea! Why don't you all come to my house? A bread party, a bread party, I'm organising a bread party!

Alina: But aren't these breads too difficult to make?

Jamuna: My chapatis are very, very simple to make, I've made them several times. You just need flour and water. If you want, you can add a little bit of salt and a spoonful of oil. You take a little ball of dough, roll it out very thinly, and put it in a flat iron pan, which we usually call tava. Tom, your idea with the bread party is fantastic. Lilu, I will bring our tava. And flour. I won't bring water though – I hope you have some at home.

Lilu: Haha, of course, I've got running water at home, I even have cold and warm water! I also have a bathroom with a shower and a big mirror and a living room with a really comfy sofa.

Stop and discuss!
We take it for granted that water comes out of the tap whenever we want. That is not the case though in many parts of the world. In many countries, (clean) drinking water is scarce.

Task: What would you like to know about drinking water? Find answers in books and/or on the Internet.

For the teacher: Questions could be: How is drinking water supplied? How many litres of drinking water do we use each day and for what purposes? How big is the share of drinking water compared with all the water on earth? (Answer: If all the earth's water – oceans, lakes, glaciers, etc. – is a bucket filled with 10 l of water, the amount of drinking water is only 4 ml.)[2] For more information on water, please go to the bathroom (→ page 33).

Asal: Jamuna, is it OK, if I use your tava to bake my taftoon bread? In Isfahan, a town in Iran, my grandfather always baked taftoon bread in a clay oven.

Taftoon bread being baked in a clay oven [3]

Jamuna: Of course, no problem.

Malaika: We bake pita bread in the oven. It's fun to look through the window of the oven. The bread – how do you say – gets bigger *(showing with her hands how the pita bread puffs up)*. At the end, it is like a pocket. We open the pocket on one side and put things inside: salad, tomatoes, falafel and yoghurt sauce.

Alina: Do you know that it's my birthday on Saturday? I'll bring scones, jam and clotted cream.

Malaika: I can't wait to celebrate with you! What are scones and clotted cream?

Alina: Scones are a British speciality – they are little round cakes – and they're really quick to make. And clotted cream is a very thick cream made from cow's milk.

The school bell rings.

Jamuna: Oh, the bell's ringing. What have we got now?

Paolo: Art lesson, great!

Scone with clotted cream and jam

Stop and draw!

Draw mandalas using ancient Egyptian hieroglyphs, Roman numerals, Hindu-Arabic numerals or other numerals.

Background information: Flatbreads

Chapatis (sometimes called rotis), pita bread and naan taftoon are flatbreads. They are made with flour, water and salt, with or without dry or fresh yeast.

Flatbreads are the very archetype of bread. They are usually baked in a clay oven, in a tava or on a saj (or sac). They are still the most common type of bread in the world. The main advantage is that they are baked very quickly (you do not need much wood, coal or gas) and you just need a hot stone or metal plate to bake them, whereas a loaf of bread requires an oven. What is more, you can use a flatbread as a substitute for a spoon when you are eating!

Chapati in a tava [4]

Pita bread being baked on a saj [5]

In Lilu's kitchen

SUMMARY

The children try to decipher bread recipes in Arabic, Hindi and Persian. This puts children from countries with Latin writing into a situation that is common for children who are not yet familiar with Latin writing: they are not able to read the text.

LEVEL

medium

DURATION

2 × 45–60 minutes (more time for making flatbreads)

VOCABULARY

milk products, berries, kitchen utensils needed to bake bread

MATERIAL

- ingredients for making bread: plain and wholewheat flour, salt, sugar, oil, dry yeast and/or fresh yeast and/or baking powder, etc. (see the recipes in the text)
- access to a kitchen with stove
- berries (if the activity is done in late spring/summer) and/or milk products
- worksheet B – Decoding recipes [1]

Safety! Beware of allergies and/or food intolerance and the heat from the stove!

The guests come into Lilu's kitchen, one after the other. Lilu is blowing up balloons for the party. Alina arrives, carrying a tin box with lots of scones. She puts two glasses of jam on the kitchen table as well as a huge bowl of clotted cream.

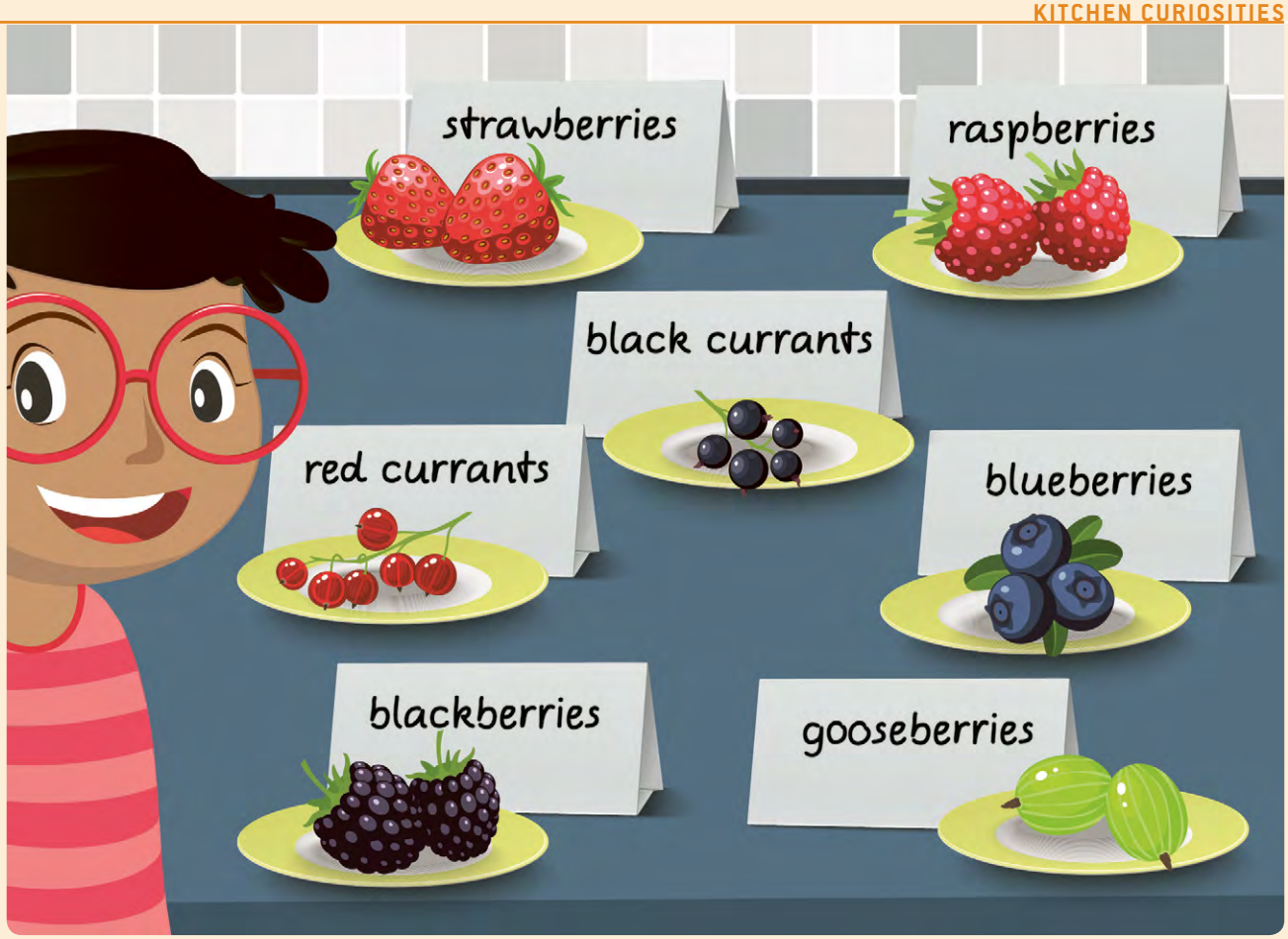
Lilu: Happy birthday, Alina!

Lilu jumps into Alina's arms, puts his arms around her neck and gives her a big kiss on the cheek.

Malaika, Asal, Jamuna: Happy birthday, Alina!

Paolo, Tom: Happy birthday, Alina!

Alina: Thank you, thank you. I'm so happy to be spending my birthday with you! Here are the scones I promised to bake. I'll show you how to eat them: put a scone on a plate. Take a spoonful of cream – by the way: if you can't get clotted cream, you can just take yoghurt. Spread the cream on the scone – like this – and then add a huge spoonful of jam. Oops, sticky fingers! I brought strawberry and cherry jam, but you can take any jam: raspberry, red or black currant, gooseberry, whatever.



Stop and jot down!

Make a list of all the milk products you know – everything that is made with milk. And/or: Make a list and describe different berries – both their appearance and their taste.

For the teacher: Milk products: milk, skimmed milk, butter, cheese, yoghurt, cream, whipped cream, sour cream, whey. Berries: strawberry, raspberry, blueberry, blackberry, red/black/white currant, gooseberry, elderberry; more rare berries: cranberry, cloudberry, aronia.

Stop and try!

The teacher could bring some milk products into class and have the children taste and compare them. If this activity is carried out in late spring or summer, the children can bring berries into class and taste and compare them.

Safety! Beware of allergies and/or food intolerance!

Recipe for 10–12 scones

- 500 g of plain flour
- 1 packet of baking powder
- 1 tbsp. of sugar
- 1 tsp. of salt
- 125 g of butter (soft)
- 250 g of yoghurt
- 2 eggs
- extra flour for working with

Mix the flour, baking powder, sugar and salt. Add the soft butter and mix. Add the yoghurt and eggs. Mix, but not too thoroughly. Preheat the oven to 200 °C. Roll the dough out 2 cm thick. Take a glass and cut out the scones from the dough. Put them on a baking tray in the oven. Bake for 15 minutes. Serve with jam and clotted cream (alternatively: yoghurt).

Lilu: Let's start to make the dough for the different breads – my parents will help us later when we need the stove.

Paolo: Alina, what kind of yeast did you use for the scones?

Alina: I used baking powder. It's a white powder that comes in little packets – look, like this.

Asal: I brought the recipe for taftoon bread. My sister wrote it in Persian.

The others: Oh no, we can't read it.

Asal: Don't worry – she gave me this table to help. Persian writing goes from right to left, but the numbers are written from left to right. You see, this is the word for 'flour' for example. And there it says that we need 200 g of white flour, 100 g of wholewheat flour, 180 ml of lukewarm water, one teaspoon of dry yeast, 1 tablespoon of olive oil and 1 teaspoon of salt.

Background information: Right-to-left writing systems

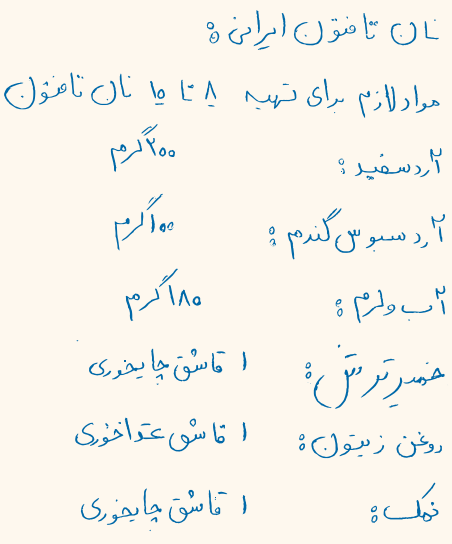
Arabic and Persian is written from right to left but the numbers are written from left to right. Hindi is written from left to right.

Malaika: Very interesting, Arabic writing also goes from right to left, and the numbers look almost the same. Look, here's my recipe for pita bread.

Paolo: Oh yes, with the help of the tables we should be able to work out the recipes.

Jamuna: I brought a chapati recipe. My father wrote it – it's in Hindi. I can only recognise the numbers, but the good news is: I know the recipe by heart. And I brought a tava.

Tava and rolling pin



نان تافتون ایرانی:

مواد لازم برای تهیه ۸ تا ۱۰ نان تافتون

۲ ر سفید: ۲۰۰ گرم

۲ ر سبوس گندم: ۱۰۰ گرم

۲ ب ولرم: ۱۸۰ گرم

خمیرترش: ۱ قاشق چایخوری

روغن زیتون: ۱ قاشق غذاخوری

نمک: ۱ قاشق چایخوری

Taftoon bread recipe in Persian

bread	نان	flour	۲ ر
taftoon	تافتون	white	سفید
Persian	ایرانی	wholewheat	سبوس گندم
ingredients	مواد لازم	water	۲ ب
gram	گرم	lukewarm	ولرم
teaspoon	قاشق چایخوری	salt	نمک
tablespoon	قاشق غذاخوری	olive oil	روغن زیتون
dry yeast	خمیرترش	10 – 8	۱۰ تا ۸

0	1	2	3	4	5	6	7	8	9
۰	۱	۲	۳	۴	۵	۶	۷	۸	۹

Persian words and numbers with translation for taftoon bread recipe

Stop and decode!

Try to find out what is written in the recipes. Use the assignment tables for numbers and the short glossaries in worksheet B – Decoding recipes. [1]

For the teacher: This activity should be carried out in small groups. If there are children in the class who speak Arabic, Hindi or Persian, they could help their classmates. If a child in the class comes from a country using non-Latin characters, he/she could bring to class a recipe (or another simple text) written by his/her family.

خبز عربي

المكونات لـ ٨ من الخبز:-

٢٥٠ غرام طحين

٧ غرام خميرة جافة

١٥٠ غرام ماء فاتر

٥,٠ ملعقة صغيرة ملح

١,٥ ملعقة كبيرة زيت زيتون

الوقت: ٦-٧ دقائق في الفرن

Pita bread recipe in Arabic

bread	خبز	water	ماء
Arabic	عربي	lukewarm	فاتر
ingredients	المكونات	salt	ملح
gram	غرام	olive oil	زيت زيتون
teaspoon	ملعقة صغيرة	baking time	الوقت
tablespoon	ملعقة كبيرة	minutes	دقائق
flour	طحين	the oven	الفرن
dry yeast	خميرة جافة		

0	1	2	3	4	5	6	7	8	9
٠	١	٢	٣	٤	٥	٦	٧	٨	٩

Arabic words and numbers with translation for pita bread recipe

Lilu: So, what do we need to start baking? You probably all need a kitchen scale and bowls?

Lilu starts to open all the drawers and cupboards in the kitchen and throws out scales, bowls, white and wholewheat flour, salt, oil – the kids are jumping around to catch everything.

Tom: Hey Lilu, be careful! One of the flour bags was open.

Stop and jot down!

Make a list of the utensils you need for baking bread. Describe what you do with each of the utensils. Example: I use a rolling pin to flatten the dough.

For the teacher: Look in the vocabulary corner [1] for kitchen vocabulary.

Stop and talk!

What ingredients do we need to bake flatbread (e.g. pita bread) or scones? Name the ingredients and check the recipes of Lilu's friends.

Asal: I brought all the ingredients I need for the taftoon bread. Lilu, do you have a piece of cling film to cover the bowl with the dough? My dough needs to sit for about half an hour.

Jamuna: I need a rolling pin.

Asal, Malaika: Me too.

Lilu: We also need pans, don't we? Here's a cast-iron skillet – wow, it's even heavier than Jamuna's tava!

Tom: Lilu, please, don't throw it!

Paolo: I brought a block of fresh yeast, smell it. And lots of olive oil and fresh rosemary. My dough also needs to sit for at least half an hour.

Block of fresh yeast and a pile of dry yeast

Tom: I didn't bring a recipe, but I thought we could do some experiments. I was wondering about the different kinds of yeast. I'd like to know what they've got in common and what's different.

Asal: That's true. Why are all these breads made with different types of yeast? And why do we need yeast at all?

Lilu: Without yeast, the bread dough wouldn't rise.

Alina: We could try to find out the best conditions to make bread dough which rises really well.

Malaika: Oh, what a great idea! We can try using dry yeast – we've got so many packets.

Stop and jot down!

Do you have an idea why yeast makes dough rise? What can you do to get the best rising result? Write down what you think and try to think of an experiment to verify your hypotheses (a hypothesis is what you expect). Do the experiment, observe it carefully and write down your observations. Write a conclusion.

For the teacher: Background information on yeast can be found on → page 49.

चपाती

मात्रा: ८-९ चपातियां

सामग्री

१३० ग्राम चोकर आटा

६५ ग्राम आटा

१२० ग्राम पानी

Chapati bread recipe in Hindi [1]

Lilu and Alina experiment

Experiment: Playing with dry yeast

SUMMARY

The children investigate the perfect conditions to make a yeast dough rise. They learn that in order to find out what influences this, they have to work systematically: they should change only one parameter at a time. The parameters are: water temperature and amount of sugar.

LEVEL

difficult

DURATION

45–60 minutes

VOCABULARY

words to describe the experiment, past tense

MATERIAL

For each group:

- 5 packets of dry yeast
- sugar
- teaspoon
- 5 bottles (0.75 or 1 l bottles)
  One of the bottles will be filled with (almost) boiling water, therefore it should be a glass bottle. The other four can be plastic bottles.
- cold, lukewarm and boiling water (to be poured by an adult)
- 5 balloons (make sure to stretch them a little by blowing air into them one or two times)
- funnel
- worksheet C – Writing a protocol [1]

Safety! Be careful with the boiling water!

Jamuna: Lilu, do you have any empty bottles? We could pour yeast and water into a bottle and see what happens.

Malaika: We'll put yeast, sugar and warm water in the bottle, and then we stretch a balloon over the bottle opening. And then let's see what happens.

Tom: Yeah, let's do that.

Lilu: But if we want to find out the best conditions for perfectly rising dough, we have to make comparisons. We should work like real scientists. If we want to know whether it's important to use lukewarm water instead of cold water, we need at least two bottles. In each one, we'll put a packet of dry yeast and sugar. And then we'll add 100 ml of lukewarm water in one bottle and 100 ml of cold water in the other bottle. Then we observe what happens. After the experiment, we'll know if it's important to take lukewarm water – as is always written in the recipes.

Lilu and the children try out the experiment. They put a packet of dry yeast and a teaspoon of sugar into each bottle.

Asal: Lilu, do you have a funnel? That would make it easier to pour the water into the bottles.

Lilu: Yes, I'll get you one.

Lilu opens a drawer and throws a funnel towards Asal. She catches it and pours 100 ml of lukewarm water into the first bottle and 100 ml of cold water into the other bottle. Malaika then takes two balloons and stretches their open ends over the bottle opening.

Conducting the yeast experiment

Stop and experiment!

Carrying out an experiment with two parameters: In all the recipes for doughs containing yeast, it can be seen that you are asked to add a small amount of sugar and lukewarm water. Would the dough also rise without sugar? Or with cold water? Or boiling water? Plan an experiment to find out the best conditions for a perfectly rising dough. Make assumptions about the expected results and write a protocol.

For the teacher: Worksheet C – Writing a protocol [1] may be used as a guideline for the protocol.

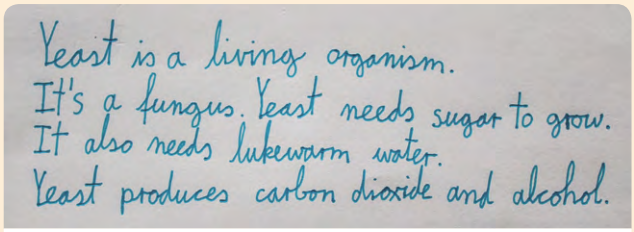
The children face the problem that there are two parameters: the temperature of the water and the amount of sugar. They should change only one parameter at a time, otherwise they cannot draw any relevant conclusions.

This is something they will encounter very often in science classes, as well as in everyday life. This is what could be written under 'How the experiment was carried out':

1. Using the funnel, we poured one packet of yeast in each of the bottles.
   - In bottle 1, we added 100 ml lukewarm water.
   - In bottle 2, we added 1 teaspoon of sugar and 100 ml lukewarm water.
   - In bottle 3, we added 2 teaspoons of sugar and 100 ml lukewarm water.
   - In bottle 4, we added 1 teaspoon of sugar and 100 ml cold water.
   - In bottle 5, we added 1 teaspoon of sugar and 100 ml boiling water (we asked an adult to help us).
2. We mixed the ingredients in every bottle. We stretched the open end of a balloon over each bottle opening.
   ⚠ **Safety!** Be careful with the hot water!
3. We observed what happened with the yeast mixtures and the balloons.

This is what could be written under 'Results and explanation':

1. Nothing happens in bottle 1: yeast needs sugar and water to produce bubbles (carbon dioxide).
2. Nothing happens in bottle 5: If the water is too hot, the yeast has no effect.
3. By comparing bottle 2 and bottle 3, you can conclude that the more sugar we added, the more carbon dioxide was produced.
4. By comparing bottle 2 and bottle 4, you can conclude that more carbon dioxide is produced when using lukewarm water.


Yeast is a living organism.
It's a fungus. Yeast needs sugar to grow.
It also needs lukewarm water.
Yeast produces carbon dioxide and alcohol.

Excerpt of a protocol: conclusion

Conclusion: A mixture of yeast, sugar and lukewarm water produces a gas. This gas is called carbon dioxide (CO_2). If you want to find out what influences your experiment, you should **change one parameter at a time.** In this experiment, the parameters are: the temperature of the water and the amount of sugar.

Background information: Yeast and carbon dioxide

Yeast: Unlike how it seems when dry, yeast is a living organism. Yeast is a fungus. As soon as you add sugar and lukewarm water, the yeast comes back to life: it eats the sugar and produces carbon dioxide – a gas which inflates the balloon. If you add boiling water, the microorganisms in the yeast die. This property of yeast – that it produces a gas – is also the reason why we use it for bread dough. It makes the dough light and airy.

Carbon dioxide, also written as CO_2, is a gas. It is invisible and it does not smell. It is a natural component of the earth's atmosphere. Without CO_2 in the atmosphere, there would be no life on earth – it would just be too cold. Too much CO_2 however is not good either: we humans emit large amounts of CO_2 into the atmosphere – e.g. by burning fossil fuels (coal, petroleum and gas). CO_2 is one of the greenhouse gases causing global warming.

Hidden sugar in flour: Not only sugar but also flour activates yeast. That means that you do not necessarily have to add sugar to a yeast dough. Flour consists mainly of carbohydrates (e.g. starch, dietary fibres) as well as water and proteins (e.g. gluten). Starch is a polysaccharide (a molecule composed of long chains of simple sugars) which serves as nutrition for the yeast fungi.

Experiment: Float or sink – How do different doughs behave in water?

SUMMARY

The children prepare three different doughs (one with dry yeast, one with baking powder, and one without dry yeast and without baking powder). They test which kind of dough sinks and which one floats.

LEVEL

difficult

DURATION

45–60 minutes

VOCABULARY

words to describe the experiment, past tense

MATERIAL

- dough recipes [1]

For each group:

- wheat flour
- lukewarm water (37 °C)
- dry yeast
- baking powder
- oil
- sugar
- tablespoon
- measuring cup
- bucket or big salad bowl
- food colouring (optional)
- worksheet C – Writing a protocol [1]

Stop and experiment!

Prepare three kinds of dough:

- Dough 1: Mix 180 g of wheat flour, 2 tablespoons of oil, 2 tablespoons of sugar and 100 ml lukewarm water.
- Dough 2: Mix 180 g of wheat flour, one packet of dry yeast, 2 tablespoons of oil, 2 tablespoons of sugar and 100 ml lukewarm water.
- Dough 3: Mix 180 g of wheat flour, 1 tablespoon of baking powder, 2 tablespoons of oil, 2 tablespoons of sugar and 100 ml of lukewarm water.

Use food colouring in order to differentiate the doughs. Take little chunks of each dough and put them into a bucket with water. Which one of the doughs will float, which one will sink? Why? Write a protocol.

For the teacher: Worksheet C – Writing a protocol [1] may be used as a guideline for the protocol.

The rest of the dough can be prepared for eating:

- The dough without yeast is similar to chapati dough. It makes great flatbread. Use a rolling pin to flatten it. Then bake in a heated pan. Flip over after a short while and bake on the other side.
- The dough with yeast is similar to a dough for bread rolls. Roll into balls of 5 cm in diameter. Let it rise for 20–30 minutes. Bake in the oven for 10–12 minutes at 225 °C.
- The dough with baking powder is similar to the dough for scones. Roll into a large ball and flatten it out (1–2 cm) on a sheet of baking paper. Scratch the surface with a cross about half way down with a knife. Bake in the oven for 15 minutes at 200 °C.

This is what could be written under 'How the experiment was carried out':

1. We prepared three different doughs:
   - Dough 1: We mixed 180 g of wheat flour with 2 tablespoons of oil, 2 tablespoons of sugar and 100 ml lukewarm water. This dough contains neither yeast nor baking powder.
   - Dough 2: We mixed 180 g of wheat flour with one packet of dry yeast. Then we added 2 tablespoons of oil, 2 tablespoons of sugar and 100 ml of lukewarm water. This dough contains dry yeast.
   - Dough 3: We mixed 180 g of wheat flour with 1 tablespoon of baking powder. Then we added 2 tablespoons of oil, 2 tablespoons of sugar and 100 ml of lukewarm water. This dough contains baking powder.
2. We poured the lukewarm water into the bucket. We took one chunk of each dough – all the chunks were the same size. We rolled the chunks into balls. We placed them into the water and waited for a while.

Bowl of water with dough chunks

This is what could be written under 'Observations':

1. At first, all doughs sink when they are placed in lukewarm water. (If the baking powder is very fresh, the dough might not sink at all.)
2. The dough with baking powder rises to the surface first. Bubbles are formed and come out of the dough.
3. The dough with yeast sinks. After a while, bubbles are formed and the dough rises to the surface of the water.

This is what could be written under 'Results and explanation':

1. For the dough with baking powder, the bubbles appear immediately. They change the density of the dough. The chunk of dough still has the same mass but the volume is bigger – this means that the density is lower. The density of the chunk of dough is even lower than the density of water. That is why the dough ball moves to the surface of the water.
2. The dough with yeast sinks first and only rises to the surface of the water after a while because the bubbles are not formed immediately. As opposed to baking powder, the yeast reacts more slowly with sugar and water.
3. The dough without either yeast or baking powder stays on the bottom of the bucket/bowl. Its density is significantly higher than the density of water.

Background information: The chemistry behind yeast and baking powder

The yeast that we use for baking is a fungus. In the warm, moist dough, the fungus and the sugar react to produce alcohol – which evaporates during the baking process – and carbon dioxide. Carbon dioxide is a gas that is also known by its chemical formula: CO_2. The carbon dioxide in the dough forms gas bubbles which make the dough rise.

Baking powder consists of both an acid (e.g. potassium bitartrate, also called cream of tartar) and a base (mostly sodium hydrogen carbonate). When baking powder comes into contact with water, the acid and the base react immediately. One of the reaction products is carbon dioxide ($NaHCO_3 + H^+ \rightarrow Na^+ + CO_2 + H_2O$). Big CO_2 bubbles form.

If the children are not familiar with the concept of density, this is the opportunity to explore it with a practical example. The density is the mass per volume.

Further activities on density

Take two identical plastic beakers. Fill one of the beakers to the rim with sugar. Fill the other beaker to the rim with cornflakes. Both beakers have the same volume (or the same size). Their masses, however, are different. Take a scale and weigh the two beakers. The beaker with sugar is heavier than the beaker with cornflakes. This implies: The density of sugar is higher than the density of cornflakes.

Experiment: Doughs with different colours

SUMMARY

The children prepare dough with cabbage juice. They add lemon juice to one part of the dough and baking soda to another part of the dough. They observe the colour changes.

LEVEL

medium

DURATION

45–60 minutes

VOCABULARY

words to describe the experiment, past tense

MATERIAL

For each group:

- red cabbage juice or fresh red cabbage (to make your own juice)
- wheat flour
- 1–2 lemons
- water
- baking soda (sodium hydrogen carbonate)
- measuring cups
- tablespoon
- bowl
- worksheet C – Writing a protocol [1]

Recipe for red cabbage juice

Chop some fresh red cabbage into small pieces (1–2 cm). Put the pieces into a plastic bag and keep it in the freezer for at least 12 hours. Put one cup of the cold cabbage pieces into a bowl and cover with really warm water (does not have to be boiling). Wait for 20 minutes. Stir and pour through a strainer. Ready to use!

The secret to this is: in the freezer, the water in the cabbage cells freezes, destroying the cell walls. When adding hot water, the red cabbage colour is now easily dissolved.

If you have any left-over cabbage juice, freeze it in a suitable container. It stays fresh for at least three months.

Stop and experiment!

Prepare cabbage juice following the recipe given above. Prepare the dough by mixing 140 g of wheat flour with 100 ml of cabbage juice. Divide the dough into three parts. Add 1 tablespoon of lemon juice to one part and 1 tablespoon of baking soda to another part. Add some more flour or cabbage juice if needed. The third dough is used for scientific control. Observe what happens and write a protocol.

For the teacher: Worksheet C – Writing a protocol [1] may be used as a guideline for the protocol. If the preparation of the dough takes too much time, the cabbage juice can alternatively be poured into three identical glasses. Add 1 tablespoon of lemon juice to one glass and 1 tablespoon of baking soda to another. Compare the colours of the different liquids.

This is what could be written under 'How the experiment was carried out':

1. We mixed 140 g of wheat flour with 100 ml of cabbage juice.
2. We divided the dough into three parts. We added 1 tablespoon of lemon juice to one part of the dough and 1 tablespoon of baking soda to another part. We mixed each dough thoroughly. The third part of the dough is used for scientific control.
3. We observed that the doughs changed colour.

Preparation of red cabbage juice

After the experiment: dough with lemon juice (pink), red cabbage juice (purple), and baking soda (blue green)

This is what could be written under 'Results and explanation': We added some lemon juice to one part of the dough and it turned pink. We mixed some baking soda to another part and it turned blue green. This shows that lemon juice is an acid and baking soda is a base. We say: lemon juice is acidic (sour) and baking soda is alkaline – the contrary of acidic.

Background information: Acids, alkalis and pH

The pH indicates how acidic or alkaline a liquid is: pH = 1: very acidic, pH = 7: neutral, pH = 14: very alkaline.

If you add a few drops of cabbage juice to a liquid, the colour changes – depending on the pH of the liquid. Cabbage juice is a pH indicator.

red: pH = 2 = very acidic (e.g. lemon juice)
purple: pH = 4
violet: pH = 6
blue: pH = 7 = neutral (e.g. water)
petrol blue: pH = 8
blue green: pH = 10
green: pH = 12
green yellow: pH = 14 = very alkaline (e.g. liquid drain cleaner)

References

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