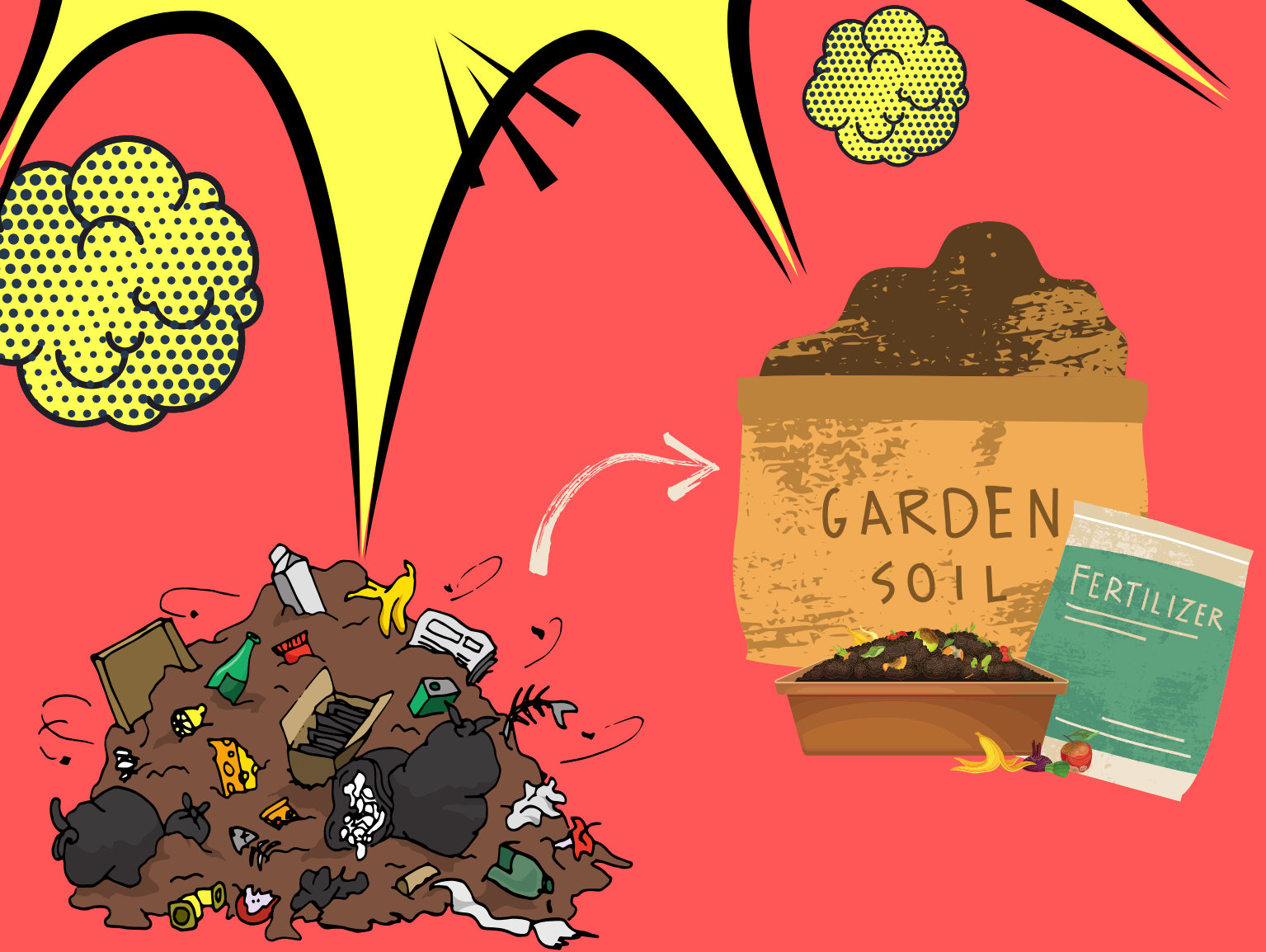


ぼかし

BOKASHI

WHAT CAN YOU DO WITH FOOD
WASTE?



NUR ASSYAKIRIN MOHAMED PAID

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PREFACE

BOKASHI: WHAT CAN YOU DO WITH FOOD WASTE? explains the concepts of bokashi by using simple jargons, easy explanation and illustration that are presented in strips of comics (mostly) to keep the attention of readers from all ages.

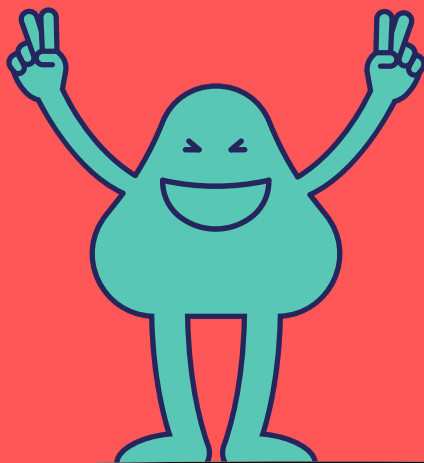
It describes the procedures of making your own bokashi bin, bran and effective microorganisms. It also explains the benefits of bokashi system and the things you can do with the waste mix and the liquid that is produced from the bokashi system. This book also discusses some of the problems that you might encounter as you start the bokashi experience.

In the last part of this e-book, I include a method to measure the efficiency of bokashi. This can be used as a reference for students if they are interested to carry out a project on bokashi.

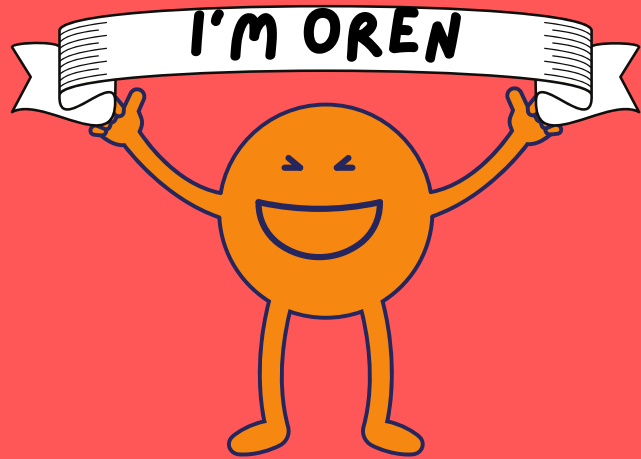
Lastly, I would like to express my utmost gratitude and appreciation to everyone who have helped in the process of completing this e-book. I certainly hope that this book will be helpful for its audience.

WHO ARE WE?

IN THIS BOOK, WE WILL SHARE WITH YOU
ALL ABOUT BOKASHI!



I'M IJO



I'M OREN



I'M YELO

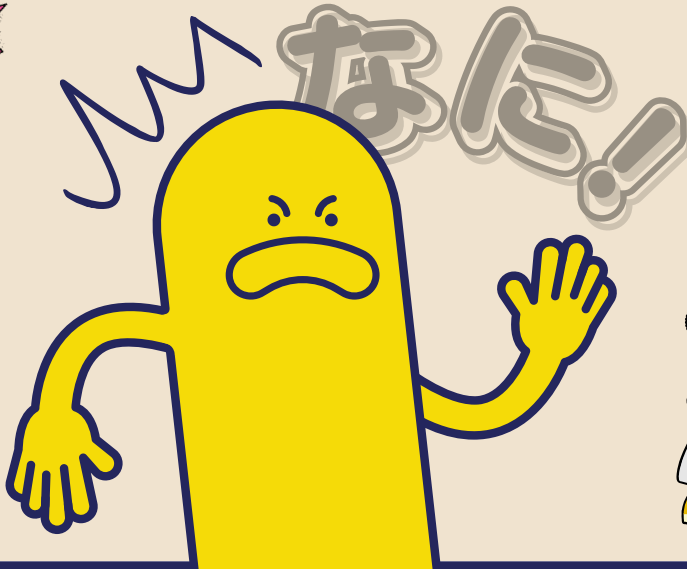
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DID YOU KNOW?

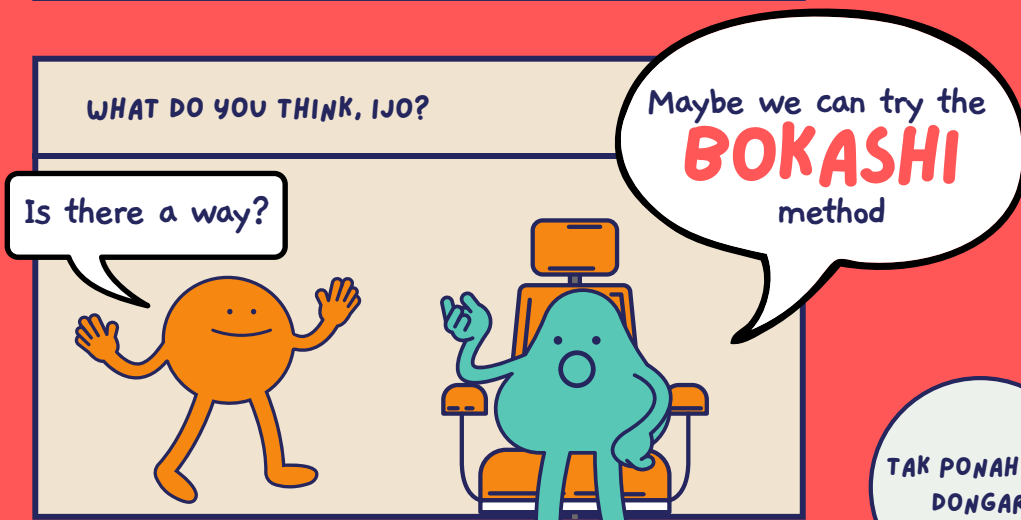
...EVERY DAY, MALAYSIANS GENERATE 15,000 TONS OF FOOD WASTE... *



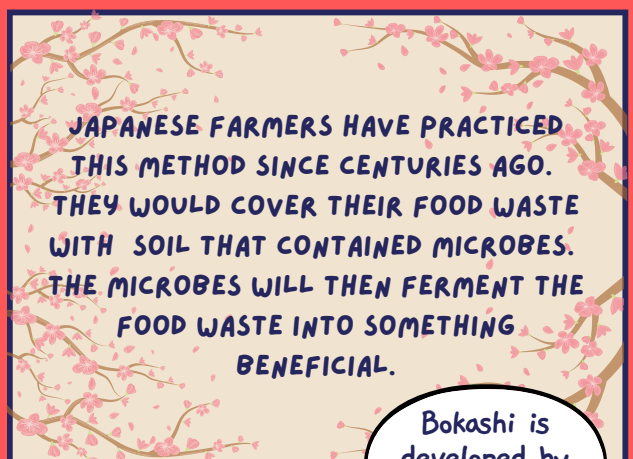
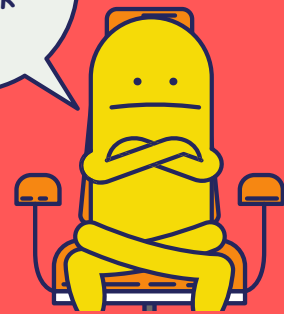
AND ALL OF THAT GO TO THE LANDFILL!



*Lew, P. S., Nik Ibrahim, N. N. L., Kamarudin, S., Thamrin, N. M., & Misnan, M. F. (2021). Optimization of Bokashi-Composting Process Using Effective Microorganisms-1 in Smart Composting Bin. Sensors, 21(8), 2847.



BUT, WHAT IS BOKASHI?



Bokashi is developed by Dr. Teruo Higa

BOKASHI IS LITERALLY TRANSLATED AS FERMENTED COMPOSTING. IT BASICALLY USES BRAN THAT IS INOCULATED WITH EFFECTIVE MICROORGANISMS (EM) TO PROCESS ORGANIC WASTE INTO NUTRIENT-RICH SOIL FERTILIZER THAT CAN BE USED TO GROW PLANTS AND CROPS.



BOKASHI VS COMPOSTING

X X X X X X X X



Bokashi is not really a composting method.

WHAT!?
WHY?
HOW?

It is actually a way of composting food waste based on the principle of fermentation.

Microbes will breakdown the food waste in the absence of oxygen.

Traditional composting needs oxygen and the nutrients can leach out into the ground.

COMPOSTING VS BOKASHI



Bokashi is actually an anaerobic fermentation unlike composting which is an aerobic process. Bokashi requires food waste and bran inoculated with EM.

AEROBIC VS ANAEROBIC

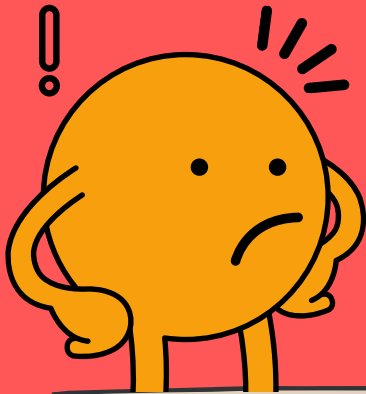
An aerobic process requires the presence of oxygen (air).



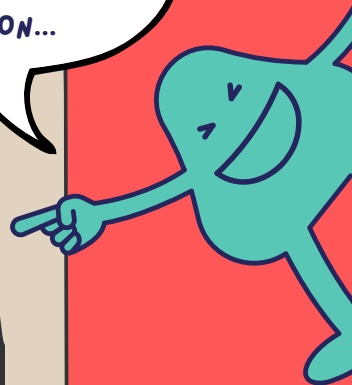
Yes, you're correct Oren. Anaerobic process, on the other hand, is the opposite of that. It does not require the oxygen (air).

Bokashi is more efficient than traditional composting. It does not lose any of the nutrients because of the airtight bokashi bin and it is also odorless.

IS BOKASHI BETTER THAN COMPOSTING?



...THIS TABLE MIGHT JUST HAVE THE ANSWER TO THAT QUESTION...



(BOKASHI) FERMENTING

COMPOSTING

2 weeks for fermenting continue for another 2 to 5 weeks under the soil



30 days to 2 years

No food restrictions except large bones



No meat, dairy, bones and citrus

Produce little to no greenhouse gases



Produce greenhouse gases

Easy to do because microbes will do the work



Labor intensive

The end product is beneficial as nutrients for plants



End product is fertile but not as rich in nutrients and microbes

Do not require any particular ratio of carbon-rich and nitrogen-rich wastes



Requires balance between carbon and nitrogen wastes



The background is a solid yellow color with a repeating pattern of various food waste icons in a lighter yellow shade. These icons include chicken bones, fish skeletons, pizza slices, french fries, coffee cups, and other common food scraps.

PART TWO

HOW BOKASHI WORKS?

WHAT DO YOU NEED IN A BOKASHI SYSTEM?

Bokashi is very easy and simple.

It requires 3 important elements to make it work.

1

BOKASHI BIN

An airtight bucket or container to put in the food waste, bran and effective microorganisms

2

BRAN+EFFECTIVE MICROBES

The bran is the special ingredient in bokashi. It is made from EM, molasses, water and a carbon-rich organic carrier like wood chips/flakes, papers or sawdust

3

FOOD WASTE

Check the list of what can and cannot be fermented using bokashi on Page 17 - 19

AN OVERVIEW OF THE BOKASHI SYSTEM



Any bucket/bin/container can be used for bokashi

Basically, we put food waste and bran in alternating layers inside the bokashi bin.



The bran has been initially inoculated with the effective microorganisms.



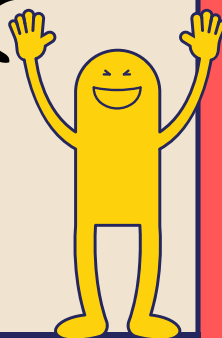
THEN, WHAT HAPPENS?

The anaerobic condition will allow the microbes to ferment the food waste. This process takes about 2 to 3 weeks.

The mixture in the bokashi bin will produce a type of liquid (leachate)*



This is similar to the process of fermenting food, only in bokashi, you are using food waste.



...IDEALLY, BOKASHI TURNS RAW FOOD WASTE INTO NUTRIENT-RICH FERTILIZER IN 30 - 45 DAYS...



BOKASHI HAS THIS SWEET AND SOUR ODOR SIMILAR TO PICKLES...

Actually, no. It will not smell bad and best of all, it will not attract pest.

Ijo, will the bokashi mix smell during or after the fermentation?

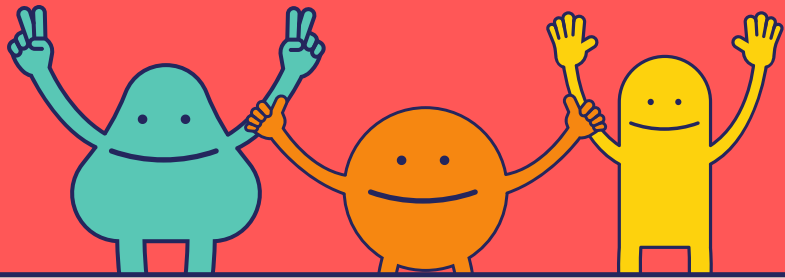
After 2-3 weeks, the food waste will not look that different but they are being broken down.

You can bury the mixture underground to allow further degradation and release of more nutrients.

This can take about 4 to 6 weeks.



*Commonly called as bokashi tea/juice



AN INSIDE LOOK INTO A BOKASHI BIN

Bokashi bins are usually a 2-bucket system with an airtight lid. If you buy the commercial ones, the bin comes with an outer bucket (with faucet) and inner bucket that has holes at the bottom. You can also make your own bokashi bin (go to page 22-23).

An airtight lid

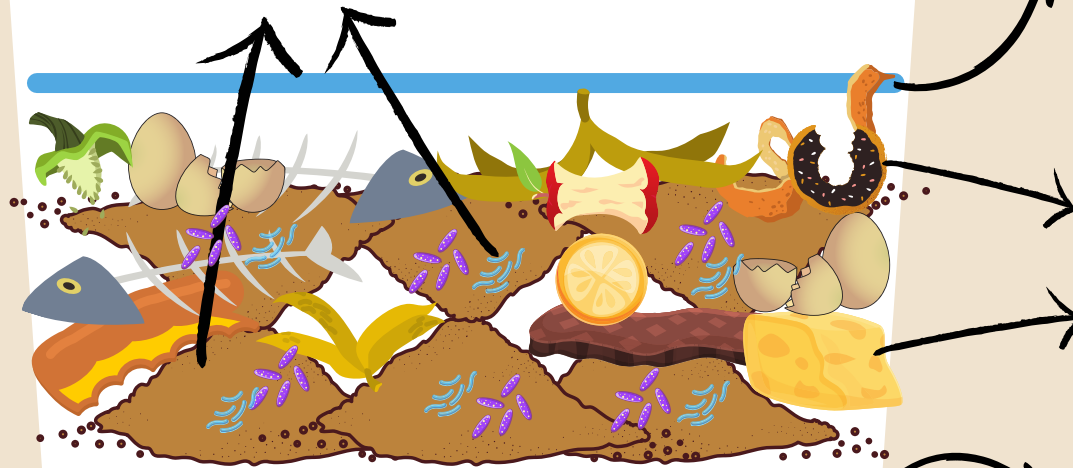
(to prevent oxygen from entering)



Cardboard

(serves as a 'presser' to make sure it is very tight inside the bin)

Bran + Effective Microorganisms



Food waste layers

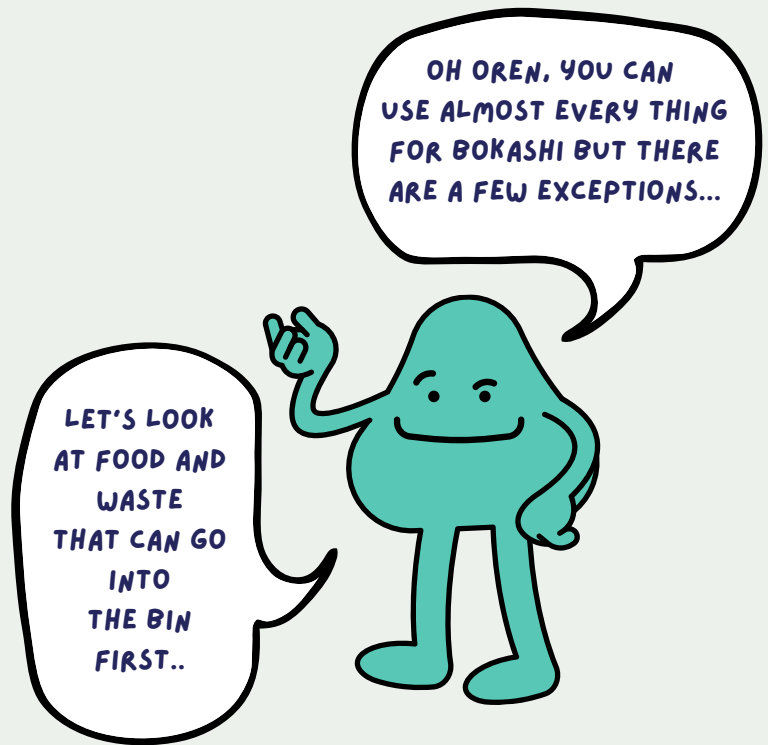
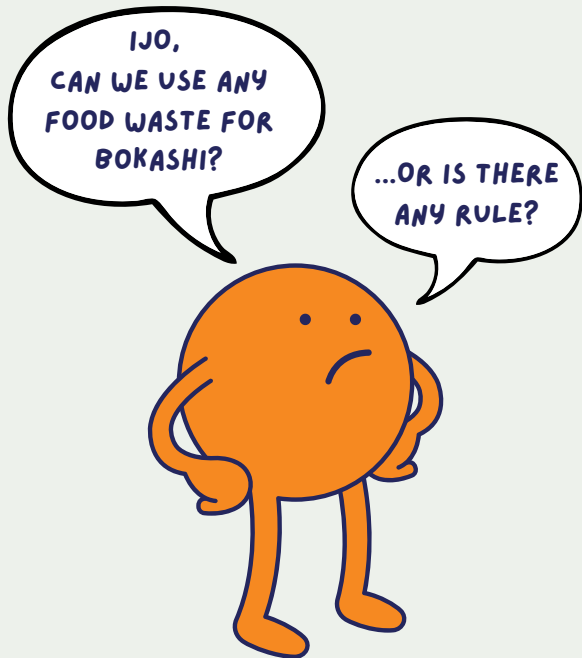
Plastic strainer/mesh/
plain holes

(To separate the food waste from the bokashi liquid)

Leachate
(Bokashi tea/juice)

Tap
(To get the bokashi liquid)

WHAT CAN AND CANNOT BE USED IN YOUR BOKASHI?





chopped fruits and vegetables



nuts and cereal



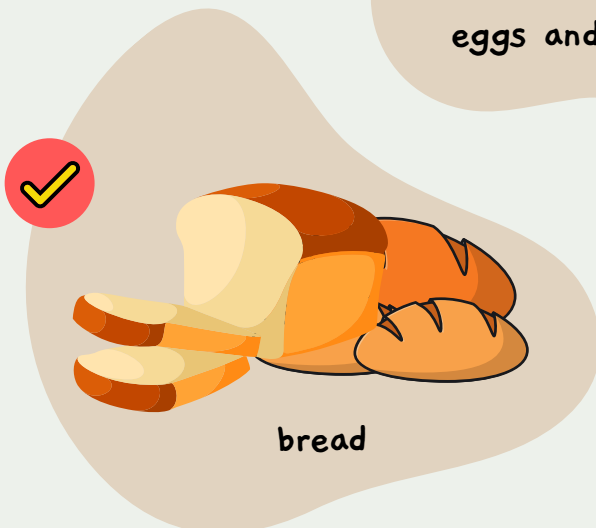
coffee grounds



tea leaves



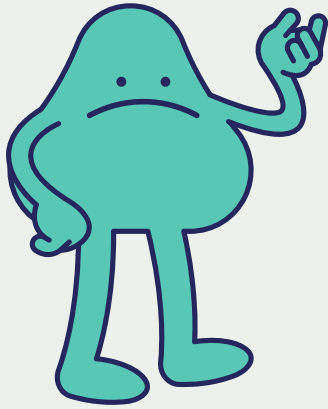
eggs and eggshells



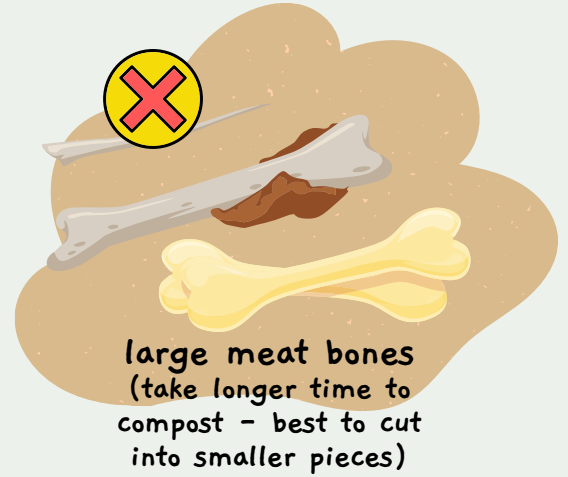
bread



cut flowers



NOW, LET'S LOOK AT THE TYPES OF WASTE THAT YOU SHOULD NOT USE IN THE BOKASHI SYSTEM.



large meat bones
(take longer time to compost - best to cut into smaller pieces)



liquids such as milk, juice, oil
(can cause bad smell and will rot instead of be fermented)



garden waste
(takes up space and does not really add value to the bokashi system)



trash
(content may not be separated between inorganic and organic)



pet waste/faeces
(may contain parasites - best to treat it rather than adding it directly into the bokashi bin)



moldy food
(precaution against pathogen like Salmonella and molds can spoil the bokashi system)



glossy or coated cardboard and paper towels, paper wraps
(contains cellulose and plastics and paper products take longer time to break down)



all plastic bags and wraps
(including the compostable/biodegradable ones - contains microplastic, additives and fillers and requires high temperature to properly be degraded)



PART THREE

HOW TO SET UP BOKASHI?

MAKING YOUR OWN BOKASHI BIN



1JO, IS IT HARD TO SET UP THE BOKASHI?

No, Yelo. It's easy. First, let's make the bokashi bin.

These are the things we need to make the bokashi bin.

1. 2 buckets with lids
2. A power drill
3. 8 cm drill bit
4. Hole drill bit
5. A faucet/tap



1 You can use old 18L paint bucket, or buy 45L garbage bin. They can be of different or similar size. The larger one will be the outer bucket.



2 Any power drill

to drill hole for the faucet
- must match with the diameter of the faucet

to drill hole for the faucet



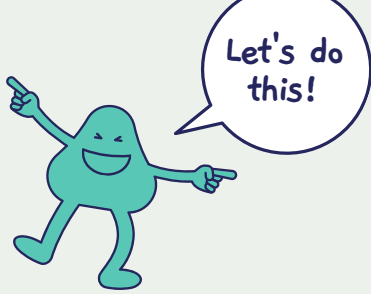
3 Drill bits



Extra items you might need; Teflon tape, goggles



5 Water faucet/tap

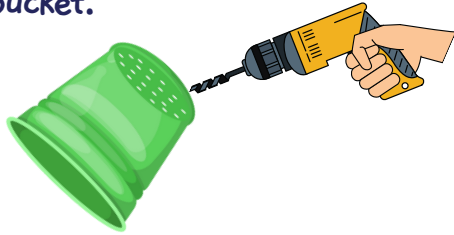


HOW?

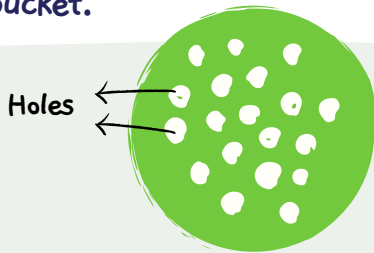


STEP 1

Take one of the buckets and use the power drill and 8 cm drill bit to make holes at the bottom of the bucket.



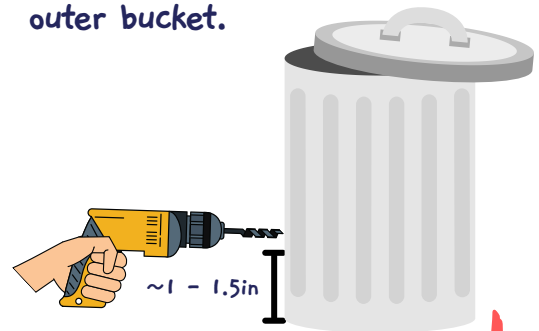
The holes should be about 2-4 cm in distance between each other. These holes will act as a filtering system. This will be the inner bucket.



1. If you use identical buckets, make sure that they can be stacked.
2. If the buckets are different in size, the smaller one should be the inner bucket and the larger one should be the outer bucket.

STEP 2

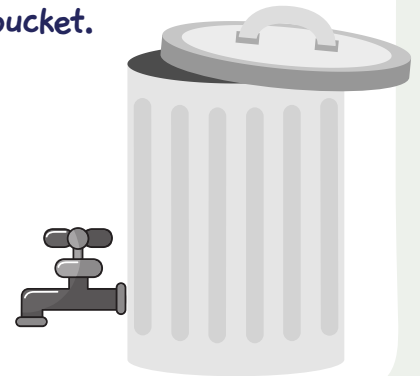
Take the other bucket and use the hole drill bit to make a hole that can fit the water faucet. It can be about 1 - 1.5 inches from the bottom of the bucket. This will be the outer bucket.



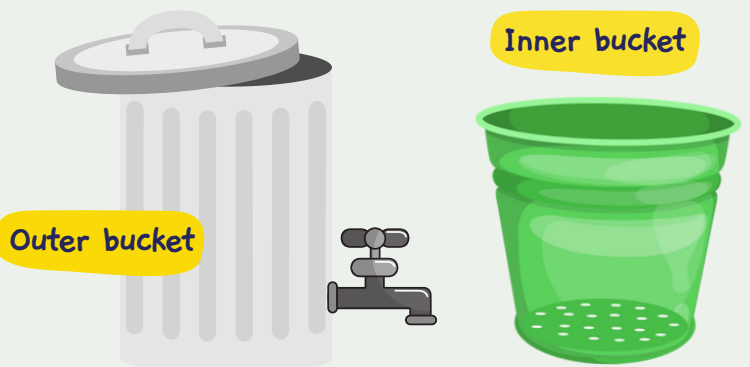
STEP 3

Insert the water faucet into the hole you made on the outer bucket.

You can use a Teflon tape or PTFE tape to ensure a good fitting.



YOUR BOKASHI BINS ARE NOW READY TO BE USED

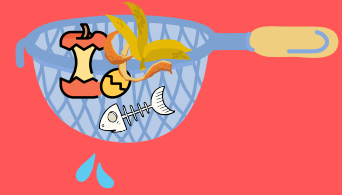


STEP-BY-STEP PROCEDURE OF BOKASHI METHOD

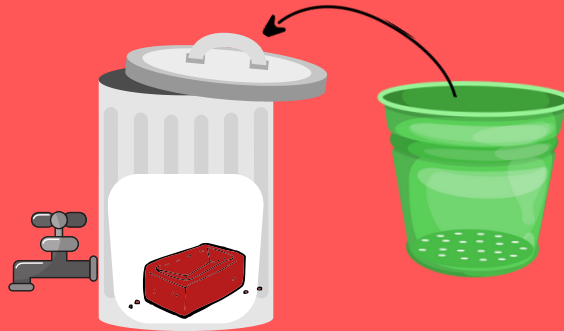


First, you have to prepare all these items to get started on your bokashi system.

- 1 Cut any large pieces of food waste into 1-4 cm pieces. Drain any possible liquid from the food waste using the strainer or colander.



- 2 Place 1 or 2 bricks inside the outer bucket. Insert the inner bucket into the outer bucket, on top of the bricks.



- 3 Create a 6 cm layer of food waste inside the inner bucket. Then, use the food mesh to compress the food waste. This removes as much air pockets as possible.



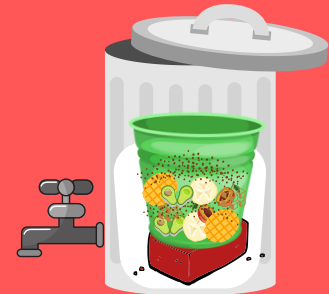
- 4 If the bran you purchased are already inoculated with effective microorganisms, you can directly pour it into the bokashi bin. Else, you have to mix the bran first with the EM solution. Another option is to make your own bran and EM (see page 27 - 28).

- 5 Then, add a handful of bokashi bran to the surface of the food waste. You can sprinkle it to spread the bran so that the entire surface layer of the food waste is covered. You can be generous with the bran but you also do not need to pour it all in. If your food waste contains a lot of proteins source, you can add a little bit more of the bran.



Add the food waste as you produce it from time to time. Then, add a new layer of bran after each layer of food waste. Remember to reseal the outer bucket with its lid after each addition. The layers appear as if they alternate.

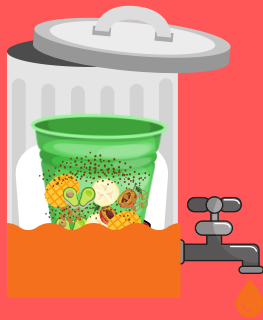
It is recommended to only open the bokashi bin once every day to prevent too much air getting into the bokashi bin. Repeat this until the inner bucket is full.



6 Once your inner bucket is full, cover the outer bucket with a large plastic bag and close the lid tightly on top of it. Let the bokashi bin sit and ferment for about two weeks.

7 Place the bokashi bin in a sheltered location away from direct sunlight.

8 Drain the accumulated bokashi liquid once or twice a week. You can use it as liquid fertilizer (but you have to dilute it first with water).



After two weeks, bury the bokashi waste mix in the garden soil or compost, in large pot or planter or even feed it to the worms (vermicomposting).

Within 2-3 weeks, the buried bokashi waste will break down into soil enriched with nutrients, microorganisms, and natural enzymes.




MAKING YOUR OWN BOKASHI BRAN

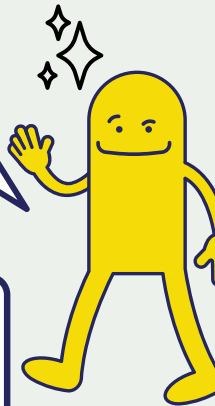


- 1 1kg Wood chips/shredded papers/wood flakes
- 2 500ml Rice water
- 3 125ml Molasses/Jaggery powder
- 4 1 Bucket & 1 bowl
- 5 5 tbsp Effective microorganisms


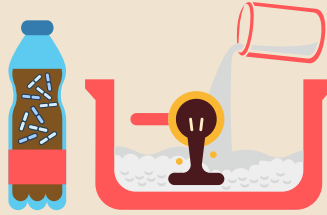
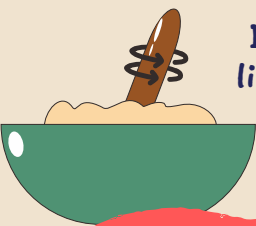

Do you know that jaggery powder is actually 'gula merah'?




You can also use coffee chaff, cocoa husk or wheat bran as the microbial carrier.



HOW?

STEP 1	STEP 2
<p>The wood chips/flakes/shredded paper act as the microbial carrier in the bokashi system.</p>  <p>First, make sure they are dry to prevent other microbes interfering with the fermentation process.</p>	<p>Pour in the rice water, molasses/jaggery powder and EM into one bowl.</p>  <p>Use any utensil to mix them together well.</p>
<p>In a large bucket, pour the liquid mixture in Step 2 into the wood chips/ flakes/shredded paper and mix them thoroughly.</p> 	<p>Seal the bokashi bran in an airtight container and leave it warm and dark place for about 2 to 3 weeks. It will smell fermented and ready to use after that.</p>  <p>You can store this for at least a year.</p>

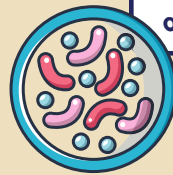
If it drips when you squeeze a handful of it, it is too wet but if it doesn't stick into a ball, it needs more liquid.



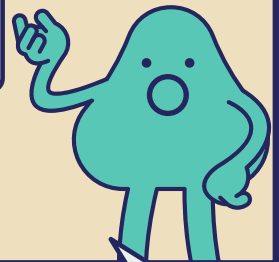
MAKING YOUR OWN EFFECTIVE MICROORGANISMS?



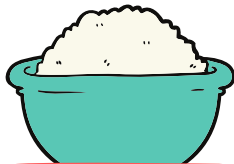
EFFECTIVE MICROORGANISMS REFER TO A MIXTURE OF IMPORTANT BENEFICIAL BACTERIA AND YEAST SPECIES MIXED AT SPECIFIC RATIOS. IT IS CLAIMED TO BE ABLE TO ENHANCE SOIL AND PLANT HEALTH AS WELL AS YIELD.



Do you know that you can make your own EM?



These are the things you need to make it.



UNCOOKED RICE



WATER



STRAINER



MILK



EMPTY CONTAINER



MEASURING CUP



CLOTH



MOLASSES



YARN THREAD OR RUBBER BAND

HOW?

STEP 1: Use the water to wash the uncooked rice in a bowl.

STEP 2: Use your fingers to stir it around inside the bowl.

STEP 3: Filter the rice water using a strainer into an empty container or jar.

STEP 4: Let the container with the rice water sit for about a week. Keep it away from direct sunlight.



You can cook the rice.
Don't throw it.

AFTER A WEEK..

The rice water will look less cloudy than the first day.

STEP 1: Mix 1 part of rice water with 10 parts of milk inside a new container. Use any measuring cup.

STEP 2: Cover the container with the cloth and tie it with the rubber band or yarn thread. ↷

STEP 3: Let the container sit for another week. Keep it away from direct sunlight.



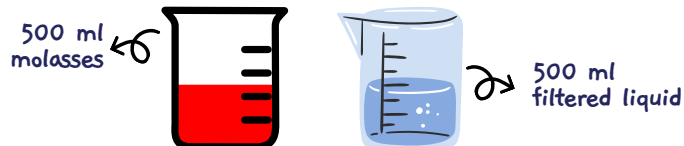
EXAMPLE:
100 ml of
rice water
should be
mixed with
1000ml

AFTER ANOTHER WEEK..

There will be separation layers visible. There will be curds floating on top. We want the liquid at the bottom.

STEP 1: Use a strainer to filter the curds and save the liquid part in a another container.

STEP 2: Add molasses to the filtered liquid using the ratio 1:1



STEP 3: Close the container tightly. Keep it away from direct sunlight.

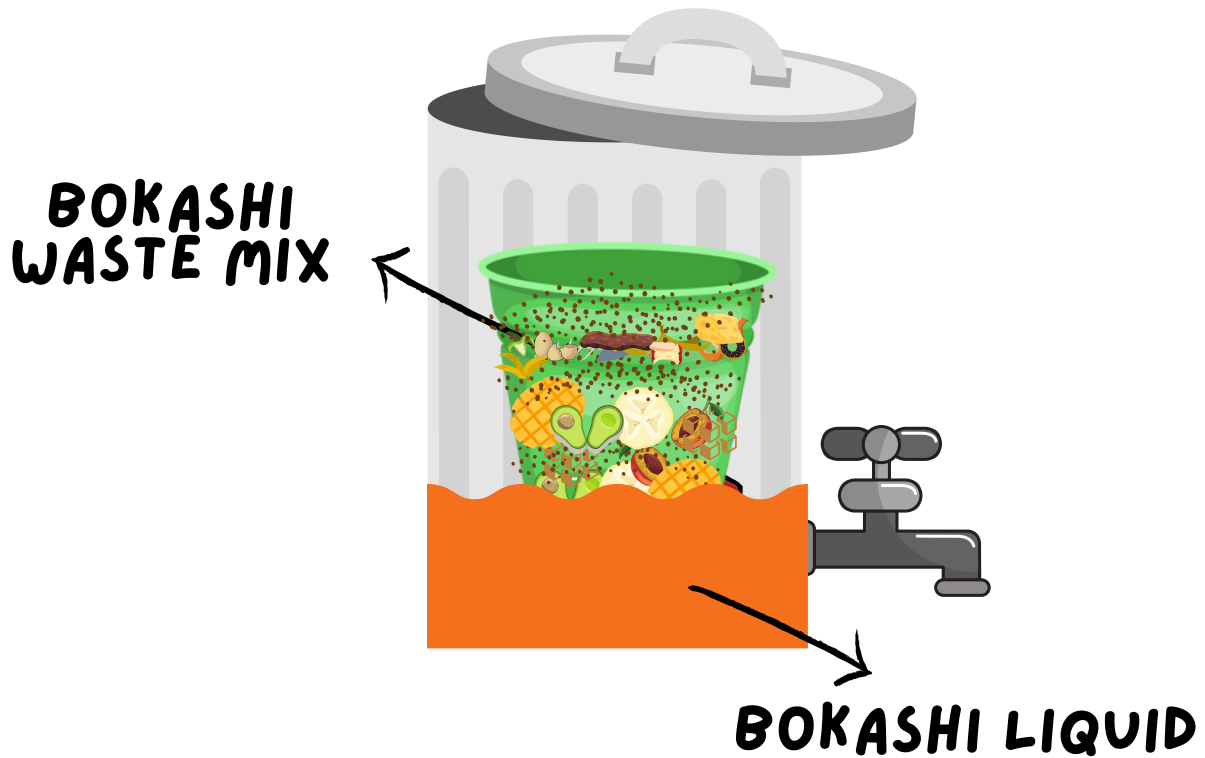


The background is a solid yellow color with a repeating pattern of various food-related icons in a lighter yellow shade. These icons include items like chicken legs, french fries, burgers, pizza slices, and other common fast-food items, scattered across the entire page.

PART FOUR

WHERE TO USE BOKASHI?

After the 2-week fermentation, you will end up with the bokashi waste mix and the bokashi liquid which you can collect through the faucet of the bokashi bin.



- 1** Do not worry if your bokashi does not produce or produce very little bokashi juice.
- 2** Both bokashi waste mix and liquid contains nutrients from the food waste and beneficial microorganisms.
- 3** Both can be used as fertilizer.
- 4** When handling these, remember to wear face mask and gloves because the waste mix may release steam and contain microorganism like legionella which can cause serious infection.

WHAT TO DO WITH THE BOKASHI WASTE MIX?



1

You can bury it directly into your garden soil around your plant or trees. Do not bury it near the roots.

Then, cover it with at least 15 cm thick of damp soil to allow composting to occur.



2

At the early stage, the bokashi waste mix can be acidic. However, it will neutralize in 7 - 10 days.

You can bury it in your compost soil first before using it for your plants.



3

After 2 months or so, the bokashi waste mix will slowly decompose in nutritious compost.



You can grow new plant or crop using it.



4

If you grow worms or do vermicomposting, you can feed the bokashi waste mix to the worms.

You should start with small amount first to get them to familiarize with it.



DON'T FORGET YOUR GLOVES AND FACE MASK!



WASH YOUR HANDS AFTER THAT

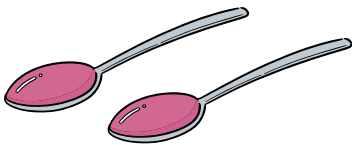
WHAT TO DO WITH THE BOKASHI LIQUID?



! THE BOKASHI JUICE MUST BE USED WITHIN 24 HOURS AFTER YOU DRAIN IT FROM THE BOKASHI BIN.

1

The bokashi liquid can be potent and acidic. It needs to be diluted in approximate ratio of 1:100 first.



**2 TSP
BOKASHI JUICE**



**1L
WATER**

That is about 2 teaspoons of bokashi juice in 1L of water.

2

You can use the diluted bokashi juice on your lawn, potted plants or garden beds.

DO NOT USE IT DIRECTLY ON PLANT FOLIAGE!



3

Undiluted, the bokashi juice can be poured directly into the drain and toilet. This actually helps algae from building up and control unpleasant odor.



The bokashi juice can clear waterway by killing competing bacteria.



PART FIVE

WHAT TO DO IF...?

THE FUNGAL PROBLEM 1



THE HOLIDAY PROBLEM



Yelo, can I leave the bokashi if I have to go for a holiday?

Sure, you can Oren.



HOW LONG CAN I LEAVE THE BOKASHI?

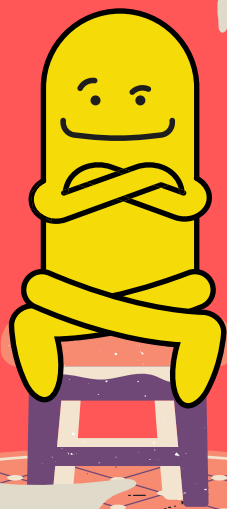
Important things you should do before leaving home

You're set to go if you do all these



Easy!

Make sure the lid is sealed tightly.

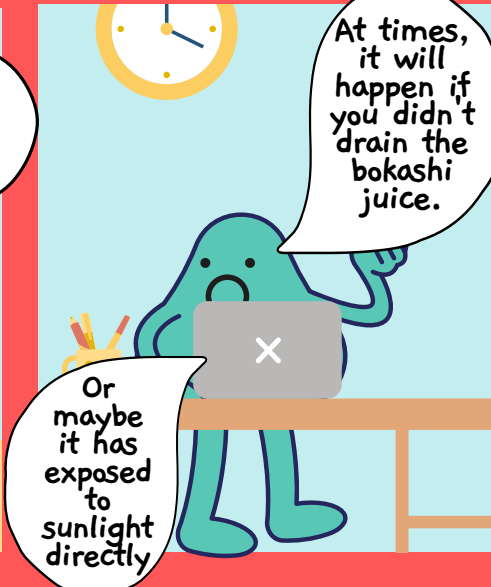
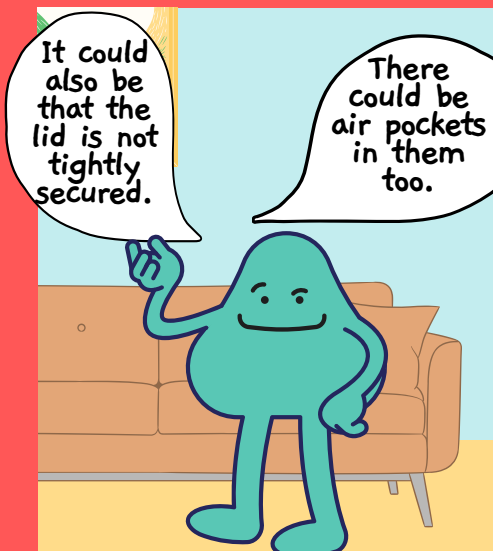
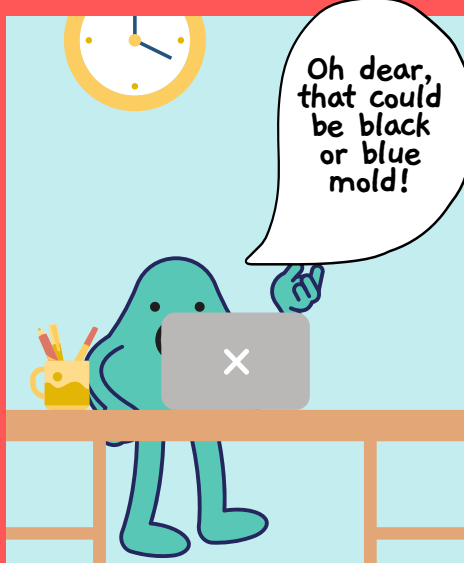
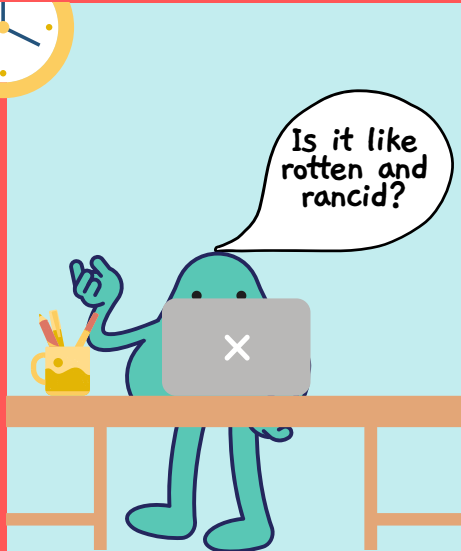


Don't forget to empty the bokashi juice from the bin before leaving.

Add a new layer of bokashi bran too!

The longer you leave the bokashi, the sweeter it will be

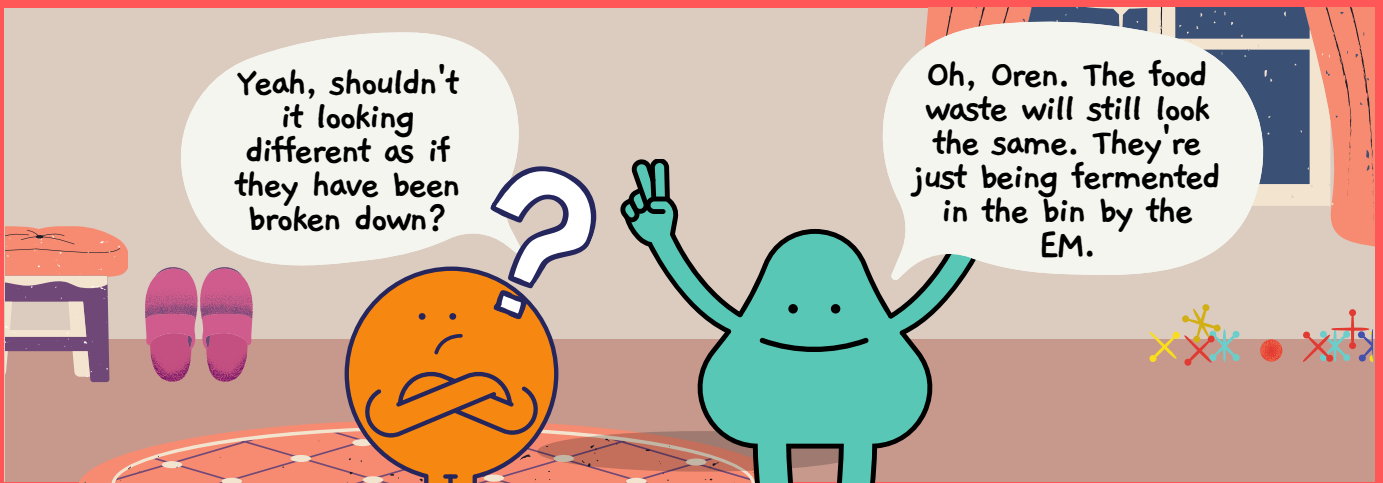
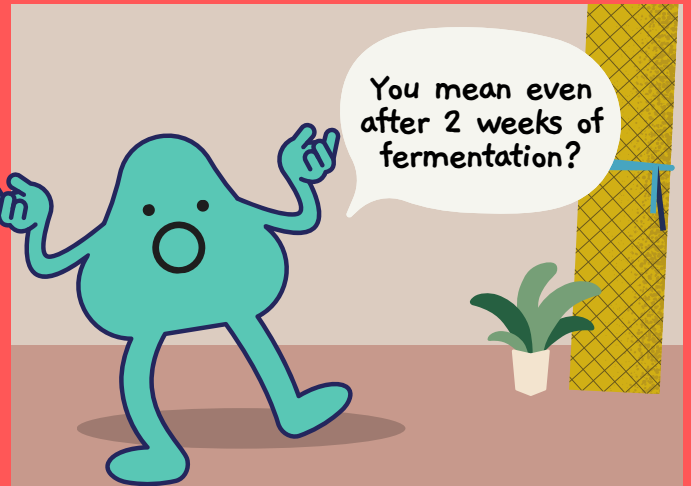
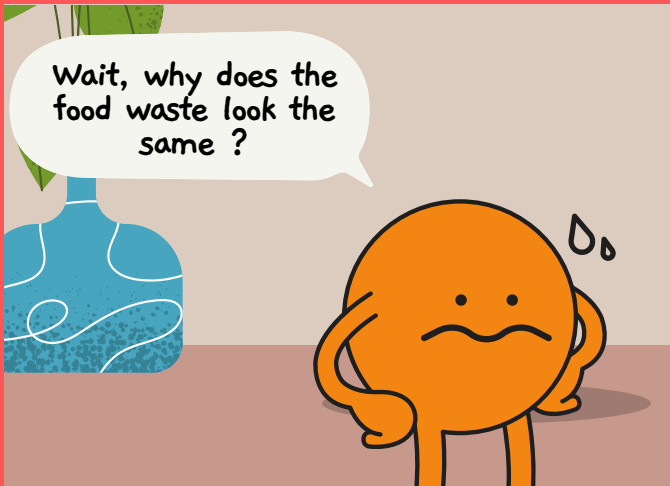
THE SMELLY PROBLEM



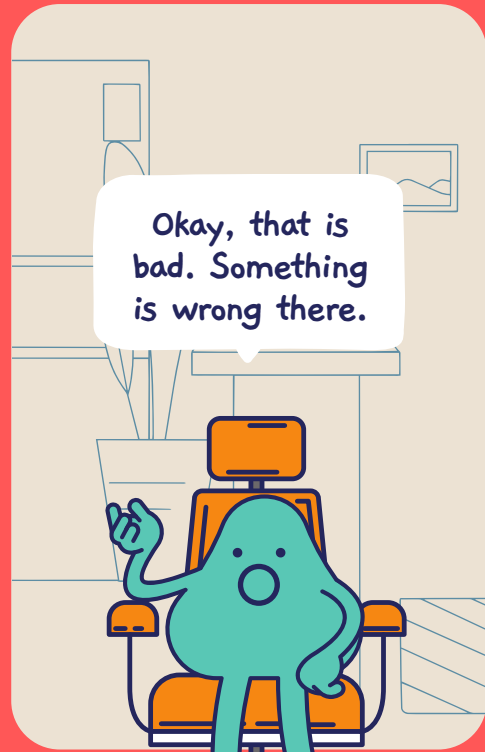
WHAT CAN WE DO?

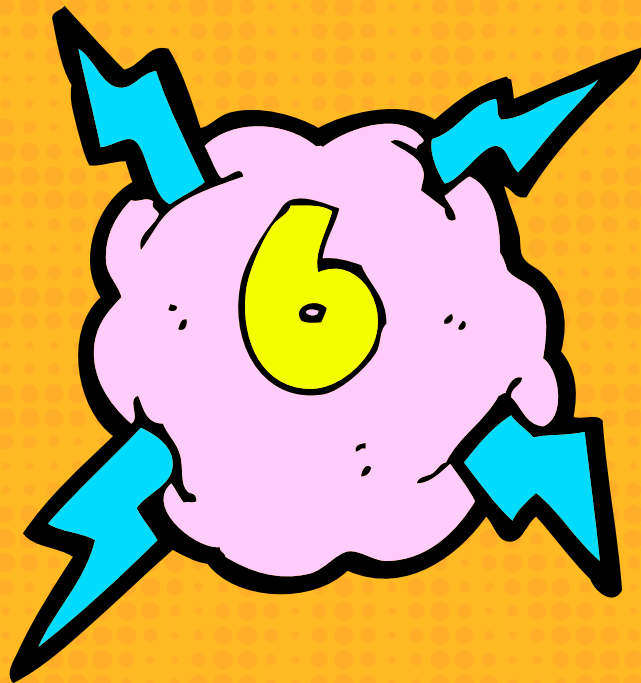
- 1** Dig a deep (about 30-35 cm) hole in your garden away from the plants or trees.
- 2** Mix all the contents with 3 handfuls of bokashi bran along with some soil.
- 3** Then, bury them in the hole and add in another 3 handfuls of bokashi bran on top of it.

THE FERMENTATION PROBLEM



THE FUNGAL PROBLEM 2





The background is a solid yellow color with a repeating pattern of various food-related icons in a lighter yellow shade. These icons include items like chicken legs, french fries, burgers, pizza slices, coffee cups, and other fast-food items, scattered across the entire page.

PART SIX

CAN WE TEST THE BOKASHI?



THE POT EXPERIMENT

DESIGN SET-UP:

1 Decide the parameters for your bokashi treatment test.

Treatment 1: Control (100% mineral fertilizer)

Treatment 2: 1 volume of bokashi : 1 volumes of soil

Treatment 3: 1 volume of bokashi : 3 volumes of soil

Treatment 4: 1 volume of bokashi : 5 volumes of soil

Example of parameter.



2 Use pots with the same diameter and capacity. Conduct the experiment in at least 3 replicates for each treatment or parameter.

3 Prepare your bokashi and determine the content of microelements such as nitrogen, phosphorus, iron, copper, zinc and manganese of each treatment or parameter. You can also determine its counts of microflora content.

Microflora includes actinomyces, fungi and bacteria.

5 Sow the seed, grow the plant and harvest it. The duration depends on the type of plants.

6 After that, you can determine the following properties:

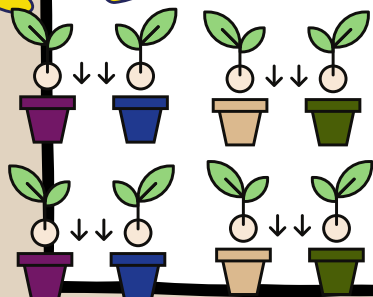
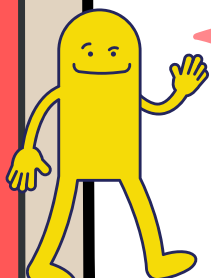
Plant fresh weight

Number of leaves

Diameter of stem

Plant dry weight

You can also measure anything relevant like the plant height



RESULTS ANALYSIS:

1 You can statistically analyzed the results by using analysis of variance (ANOVA) for the randomized complete block design via any statistical software.

2 You can compare the means of the treatment using Duncan's Multiple Range Test at 5% level of probability.

SPSS is an example of statistical software.



BOKASHI: IN A GLIMPSE

The fermentation process will not change the appearance of the food waste.



White mold is good. Black, blue, green, red mold are bad.



After the fermentation process, the bokashi will smell sweet like vinegar.



Use more bran when adding food waste that is harder to break down such as bones and meat as well as on slightly moist food items.



Definition of **BOKASHI**

Bokashi is a method of composting food waste based on the concept of fermentation using effective microorganisms in an airtight container

HOW-TO

BOKASHI

Layer the food waste and inoculated bran in the bokashi bin. Make sure there is no air pockets and fill the bin only once a day until it is full. Then, let it sit for about 2 weeks.

Benefits of **BOKASHI**

1. It can ferment almost every kind of food waste
2. It contains nutrients and microbes that are good for the soil and plants
3. It does not smell bad
4. It does not attract pest
5. It shortens the composting duration later

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SAVE
the
PLANET

We can start small with
BOKASHI

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Bokashi: What Can You Do
with Food Waste?