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Lacto fermentation
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What is lacto fermentation?

Fermenting food or beverages is a process which involves micro-organisms converting a substrate into an acid or alcohol.

The 'lacto' in 'lacto fermentation' refers to a micro-organism which is a specific species of bacteria namely lactobacillus; various strains of these bacteria are responsible for a lacto fermentation.

The basic process of a lacto fermentation is to create the right environment for these micro organisms to flourish and can either be left to a wild fermentation or more controlled with a cultured fermentation.

Wild fermentation
A wild fermentation is one that occurs spontaneously from the lactobacillus bacteria that are on vegetables, in the air & all around. The bacteria digest sugar from the fermentation substrate and in the process create lactic acid which acts as a preservative like sauerkraut, kimchi & dill pickles.

Cultured fermentation
A cultured fermentation is made by adding specific bacteria to aid the fermentation. For example yogurt, kefir and kombucha rely on a culture being added.

History

Writings and drawings from around the world show that nearly every civilization, since early times, has included fermented food in their culture. Many of the fermented milk products we are familiar with today were developed by nomadic Asian cattle breeders & fermented breads can be traced back to the Egyptians. The varieties of fermented foods and drinks that evolved were dependent on the raw materials that were available in a local environment together with cultural taste preferences.

The process of lacto fermenting vegetables has been used for thousands of years in a number of cultures as a way of preservation. Lacto fermented sauerkraut is historically popular in Eastern Europe. Asian cultures have long fermented vegetables including the famous kimchi. Some African cultures used fermentation to remove cyanide from cassava roots that otherwise would be poisonous.

Methods of lacto fermenting dairy & vegetables have been passed down through generations for thousands of years. Our modern day western diet lost many of these traditions until recently when we have seen a revival.

Benefits of fermented foods

- ♥ makes food easier to digest
- ♥ helps support a healthy gut.
- ♥ increases beneficial compounds.
- ♥ improves bio availability of nutrients.
- ♥ can remove toxins from food.
- ♥ preserves foods for later use.
- ♥ minimises food waste.
- ♥ increases food security.
- ♥ energy efficient to make & store.
- ♥ tastes delicious

Equipment ~ vegetables

To lacto ferment vegetables, all the equipment you really need is a good knife, a wooden board, a jar with a lid, a weight and a cloth, it really is as simple as that.

Vessels
Glass is a good option for fermenting vegetables as it's easy to see the fermenting material and monitor progress.
Try to have a store of mason or kilner jars in various sizes.

Ceramic made from clay, is fired at a high temperature and includes earthenware and porcelain. There are many kinds of ceramic containers that you can utilise for fermentation.

Lids -Ferments need protecting from flies but at the same time gases must be able to escape. You can cover with cloth, muslin is a good choice, secured with a rubber band or string, the cloth will keep pests out and at the same time allow a way out for the gas by products of fermentation. Tight fitting jar lids are an option but need daily attention to loosen the lid and reduce the build up of gas pressure. It is possible to buy a variety of lids with a fitted airlock sealing the jar but allowing gas to escape.

Weights - Keeping vegetables submerged under liquid during fermentation is essential. A smooth stone, sterilized in boiling water for 5 minutes, a glass jar filled with water or a bought ceramic fermentation weight are all good options.

Equipment ~ dairy

To ferment milk the equipment is very simple and you can manage without any expensive gadgets

Yoghurt
You will need a saucepan, a thermometer, a wide mouthed vacuum flask and some jars.
You can certainly use a yogurt maker if you have one, they are good at holding the yogurt at a steady temperature as it incubates but it is not necessary to buy one.

Kefir
You simply need 1 or 2 glass jars with lids, a strainer, a glass jug plus glass bottles to store the finished kefir in the fridge

Ingredients

Vegetables

If you are new to fermenting the following vegetables are all good choices. Source organic not only to help ensure success but for your health & the health of the planet.

cabbage · radish · turnip · carrots · celeriac · kohl rabi
beetroot · string beans · cauliflower · asparagus

Some vegetables like summer squash & cucumbers can go mushy so benefit from the addition of a high tannin leaf like vine, horseradish or oak.

Leafy greens like chard and kale can taste a bit strong, it's a personal preference but they often work better in combination for example kale & celeriac.

Ripe tomatoes can turn to alcohol, green tomatoes are a better choice. Aubergine works best with strong flavours – ginger, chilli, garlic, oregano.

Dairy

Kefir

Kefir can be made from any dairy milk – cow, sheep, goat or buffalo. Raw (unpasteurised) bio-dynamic or organic full fat milk is best; alternatively choose pasteurised bio-dynamic or organic full fat milk.

Yogurt

This too can be made from any dairy milk. If you are new to yogurt making its easier to make with pasteurised milk but choose biodynamic or organic full fat milk.

Non dairy

From both a nutritional & environmental perspective hemp is the best non dairy option.

Key considerations for perfect fermented vegetables

Organic vegetables are best
Organic vegetables are free from chemical pesticides which, when you ferment, can stop the growth of essential bacteria. Research has shown there are more minerals, vitamins and phyto-nutrients, in organic vegetables which means your ferments will be brimming with nutrition.

Water
Use filter water if possible. Make sure if you use chlorinated tap water you leave the water, overnight, in an open container with a large surface area to evaporate off the chlorine.

Type and quantity of salt
Do not use refined, kosher or pickling salt. Do use fine grain mineral rich salt like Himalayan pink salt or sea salt like Celtic sea salt.

Salt is used in the fermentation process to inhibit unwanted microbes, to pull the liquid out of vegetables, to keep vegetables crisp, to prevent mould and to enhance flavour.
dry salt ratio - 2% salt to vegetables (20g salt to1 kilo prepared veg)
brine ratio - 2 - 3% salt to water (20-30g salt to1 litre water)

Keep vegetables submerged
Fermenting is an anaerobic process. Use some sort of weight to keep fermenting vegetables totally submerged under liquid at all times.

Maintain the ideal temperature
Whilst not essential throughout the entire fermentation, an ideal temperature of 65 – 70ºF/ 18 -21ºC is important during the first few days of fermentation when the lactic acid bacteria are creating the lactic acid necessary to preserve your vegetables.

Sauerkraut

1k white cabbage
20g sea salt

Finely slice the cabbage & place in a large bowl.

Add the salt & massage until the juice starts to flow.

Place about 2" of cabbage into a wide mouthed glass jar and press firmly down.

Repeat until one inch from the top of the jar.

Ensure the cabbage is covered with brine add a little water if necessary.

Weight the cabbage down & loosely cover with a cloth.
Let the jar sit at room temperature away from direct sunlight. Check daily that the cabbage stays submerged, adding a little water if necessary.

After a week, taste the cabbage and see if it's the right flavour for you. If not leave a little longer (up to another 2 to 3 weeks)

Once its ready fasten with a lid & store in a cool dry place Unopened will last a year. When you start eating the cabbage keep in the fridge.

Red cabbage, apple & juniper kraut

1k red cabbage
2 Granny Smith apples (or similar)
20g salt
tablespoon juniper berries roughly ground in pestle & mortar

Very finely shred the red cabbage and place in a bowl.

Add the salt & massage the mixture until you have plenty of liquid.

Core the apples, finely chop & add to the cabbage with the juniper berries.

Pack into a wide mouthed jar pushing down well. Ensure the vegetables are covered with liquid adding a little water if necessary.

Weigh down to keep the vegetables submerged, cover with a cloth.

Ferment in a warm place away from sunlight for 1 – 2 weeks. Check regularly to ensure the mixture stays submerged.

When it tastes to your liking, loosely fasten lid & store in a cool dry place. Unopened will last for at least 6 months.

Mixed root kimchi

1 litre brine (1 litre water/2 rounded tablespoons salt)
3 turnips
3 carrots
3 Jerusalem artichokes
2 tablespoons freshly grated ginger root
4 cloves garlic, chopped
2 chillies, chopped (with or without seeds)

Peel & finely slice the vegetables, place in a bowl, pour over brine & leave overnight.
Blend spices together into a paste.
Drain the vegetables from the brine (reserving the brine).
Taste vegetables for saltiness. You want it to taste salty but not unpleasantly so.
If they are too salty, rinse them. If you cannot taste salt, add a bit more.
Mix the vegetables with the spice paste & pack into a wide neck jar like a kilner.
Press down tightly.
Add some of the reserved brine to ensure the vegetables are submerged.
Weigh the vegetables down, cover with a cloth and leave in a warm place away from direct sunlight for at least a week.
Taste them and when fermented to your liking, fasten lid & store in a cool dry place or refrigerate.

Waste not kimchi

Almost any vegetable can be fermented. The following recipe works best with hard vegetables, it is a simple technique to ensure all your vegetables are used up and never wasted Beets, sweet potatoes, turnip, carrots, peppers, turnips, kohl rabi, swede, pumpkin, parsnip whatever needs using up!

Spices & herbs to use for each 500g of vegetables.
2 tablespoons grated ginger, 4 cloves garlic, chopped, 1 tablespoon chili flakes, 2 tablespoons chopped chives, 2 tablespoons chopped parsley

Grate the vegetables add a tablespoon salt, for every 500g of vegetables.

Massage well together to pull the juices out of the vegetables. Mix in the spices & herbs, pack into a wide neck jar like a kilner.

Press down well to ensure the vegetables are covered with brine adding a little water if necessary.

Weigh down to keep the vegetables submerged, cover with a cloth. Ferment in a warm place away from direct sunlight for 7 days.

Fasten lid & store in a cool dry place or refrigerate. Unopened will last for at least 6 months.

Radish kimchi

500g French breakfast radish
1 tablespoon salt
1 tablespoon chopped chilli
1 tablespoon grated ginger
3 cloves garlic diced
1 heaped teaspoon of sweet white miso mixed with 200ml water

Trim the radishes but leave some of the leaves intact.
Wash the radishes, drain well, then cut in half.

Place in a bowl and toss with the salt, let stand for 30 minutes.

Add the seasonings, mix well then pack into a jar.

Pour over the miso mixture and ensure the radish are covered.

Weigh down to keep the radish submerged, cover with a cloth.

Ferment in a warm place away from direct sunlight for 5 days.
Fit a lid and store in the fridge – eat within 2 weeks.

Beets fermented with horseradish

500g beetroot, peeled and grated
2 rounded tablespoons freshly grated horseradish
10g salt

Mix all the ingredients together in a bowl.

Place them into a sterilised jar.

Pack the beetroot down to eliminate all the air.
There should be enough brine to cover the beetroot.
If there is not enough brine add a little water

Place a clean weight on top to keep the beetroot submerged
Cover loosely with a cloth to keep flies out.

Leave to ferment for 7 days in a warm place away from direct sunlight.

Taste to see if it is tangy enough, if not allow to ferment a little longer.

Remove weight, loosely fix a lid, refrigerate & start using.

Fermented celeriac with turmeric

2 medium celeriac peeled
1 tablespoon salt
1 tablespoon freshly grated turmeric
1 chilli finely chopped
1 teaspoon freshly ground black pepper

Grate the celeriac on the large hole side of a grater.
Place in a bowl and massage in the salt for about 3 minutes.
Stir in the turmeric, chilli & black pepper.

Pile into a wide neck jar pushing down as tightly as possible to submerge the celeriac under the brine. Place a weight on top of the mixture to ensure the celeriac stays submerged.

Cover the bottle with muslin and leave to ferment for 7-10 days in a warm room approx 65ºF/18ºC away from direct sunlight.

Start tasting after 7 days and when it reaches a flavour you like, remove the weight, pop on the lid and store in a cool, cupboard or the fridge. Unopened will last for at least 6 months.

Fermented chilli sauce

There are many variations of this handy condiment – this is a pretty foolproof method.

chillies – whichever ones you fancy
a few peeled cloves garlic
a few peppercorns
brine (1 rounded tablespoon fine salt/500ml chlorine free water)
apple cider vinegar (roughly 2 tablespoons to 500ml sauce)

Pack a wide necked jar fairly tightly with chillies & toss in a few cloves of garlic & some peppercorns. Cover with brine. Weigh down to keep the chillies submerged & cover with a cloth.

Ferment in a warm place away from sunlight for 7 days. Strain & save the brine.

Blitz the chillies, garlic & peppercorns in a blender with apple cider vinegar to taste & enough brine to make a sauce.

Pour into sterilised bottles, fasten a lid and keep in the fridge. Unopened will last for at least 6 months.

Sour dill pickles

500g pickling/ridge cucumbers
2 medium vine leaves
1 medium bunch fresh dill
1 onion - peeled and sliced
6 garlic cloves, peeled
1 tablespoon black peppercorns
1 tablespoon mustard seeds
brine – (2 rounded tablespoons of fine grain salt to 1 litre of water)

Soak the cucumbers in cold water for 2 hours.
Drain & cut the blossom end off the cucumbers.
Place 1 vine leaf & the spices in the bottom of 1 litre, wide mouthed lidded jar.

Pack the cucumbers into the jar vertically trying to get as tight a fit as possible.

Pour the brine over the cucumbers to cover them. Cover with a grape leaf tucking the edges down into the jar.

Place a weight on top to make sure the cucumbers stay submerged in the brine. Loosely lid and set on plate to catch any brine overflow.

Ferment in a warm place (20 – 22ºC) for at least 5 days but up to two weeks.
Taste them and when pickled to your liking, refrigerate.
Use within a year

Dairy milk kefir

When you add kefir grains to milk, they consume the lactose in the milk, producing a fermented beverage that's teeming with beneficial bacteria and yeast.

1 tablespoon milk kefir grains
500 ml whole milk

Place the grains into a clean glass jar & add the milk.

Loosely cover the jar and leave for 12–24 hours, stirring occasionally with a wooden spoon. The milk will become thick and effervescent. Optimum temperature is 22ºC/71ºF don't let it fall below 16ºC/60ºF

When thickish and soured to your liking, strain the kefir through a clean strainer and collect the grains.

Its ready to drink at once though you may prefer it chilled. You can store the kefir in the fridge for up to a week.

The grains can be stored in the refrigerator in a little fresh milk, but the kefir grains thrive best when they are allowed to spend most of their time working that is culturing milk into kefir.

Hemp milk kefir

200g shelled hemp seeds
4 dates, soaked for 12 hours
good pinch salt
1 tbsp milk kefir grains

Blend the hemp, water, dates and salt in a high-speed blender until smooth. Strain through muslin (cheesecloth), squeezing well to remove excess liquid.

Pour the hemp milk into a large glass jar, add the kefir grains and stir in with a wooden spoon. Cover with a cloth and leave in a warm place for 12–24 hours. The mixture will thicken and become tangy.

Strain the grains and store the hemp kefir in a glass jar in the refrigerator for up to a week. It will separate out, but stir or shake it back together. Repeat the process. Whilst milk kefir grains will make plant kefirs the grains do not flourish in the same way and after a while they can give up.

Yogurt

Once you start making your own yogurt reserve a couple of tablespoons each time to start the next batch.
1 litre organic whole milk
2 rounded tablespoons of plain live yogurt as a starter culture

Heat the milk gently in a pan to 43°C/109°F.

Remove from the heat and whisk in the yogurt.

Pour into a warmed 1 litre thermos, fix the lid and leave for 8 – 12 hours depending on your thickness and flavour preference.

Pour into clean jars and store in the fridge.

Eat within a week.

Troubleshooting ~ fermented vegetables

Problem	Why has this happened?	What shall I do?
No bubbles to show your ferment is working	There probably are bubbles and you just can't see them. They are most active in the first few days as the first bacterial strain eats the sugar in the vegetables.	All ferments progress in their own particular way, so it's unlikely a cause for concern. If you press down with your weight you will probably see a few bubbles rising. If your room is cold there will be less bubbles so you could move to a warmer spot.
White, creamy, powdery layer on top of vegetables that looks like mould but is a yeast called kahm	Kahm yeast appears at the beginning of fermentation before the high acidity level of your ferment is reached. More likely to appear in warm weather, with sweet vegetables or if not enough salt is used	Kahm yeast is harmless but will affect the taste of your ferment. Scrape it off, though it can be hard to completely remove & can reappear
Mould of all colours, green, black, pink, orange.	Mould spores are everywhere and the nutrient-rich surface of your ferment in contact with the oxygen rich air is a perfect place for them to flourish	Remove all mould at once. If you catch it early the ferment below will be fine. If significant mould has effected smell & taste, throw it away.

Troubleshooting ~ fermented vegetables

Problem	Why has this happened?	What shall I do?
slimy, thick & stringy brine	This is most likely to happen at the beginning of a ferment and is generally the result of certain bacteria together with high sugar content vegetables. It can happen when the temperature is too high or too little salt is used	Wait and see what happens, as the ferment progresses it may just go away, if not throw it out. In future use less sweet vegetables like carrot, beetroot & Jerusalem artichoke. Ferment at lower temperature
Soft & mushy	Warm temperatures and low salt can cause this. The length of time you leave your ferment before eating will make a difference as enzymes over time will eventually reduce crunchiness	If you prefer it crunchy make sure you add enough salt and avoid fermenting in warm temperatures. It is perfectly safe to eat a soft, mushy ferment, some people prefer it this way.
flies & maggots	Because you have not protected your ferments from flies, flies are most prevalent in the summer months but fruit flies can be around all year.	If there are maggots in your ferment they are generally in the top layer which you can remove, the rest will probably be OK or if you prefer you can just tip the lot on the compost. If its fruit flies just skim them off. In future remember to secure a piece of muslin over the top of your ferment.

Troubleshooting ~ kefir

Problem	Why has this happened?	What shall I do?
You have some new kefir grains but they do not seem to be working	Kefir grains can take a few days to settle down to a new environment	Try a couple of times then, if your milk is not thickening or smells bad, the grains are most likely dead!
Your kefir is taking a long time to thicken	Ratio of grains is not correct. Temperature not right	The ration of grains to milk is not an exact science but 1 heaped tablespoon to 500ml milk is about right. Add more if the milk isn't thickening and move to a warmer place
Your kefir thickens too quickly	Temperature too hot. Ration of grains to milk not correct. The ideal culturing time is 14 - 16 hours	The ideal temperature is around 75ºF, if grains are too active lower to 65ºF. Use less grains
I have too many grains	Kefir grains, given the right environment naturally replicate	Give them away, add the grains to smoothies or dry them on a cloth at room temperature and store in the fridge as a backup supply

Glossary

aerobic bacteria ~ *bacteria that require oxygen to thrive*

air lock ~ *allows gases out but no air to enter the ferment*

anaerobic bacteria ~ *bacteria that flourish without oxygen*

brine ~ *a solution of salt in water*

culture ~ *the introduction of organisms to start a ferment*

dry salting ~ *salting a food without the addition of water*

fermentation ~ *the metabolic transformation of foods via the action of microbial organisms*

kefir ~ *fermented dairy milk or plant based milk*

kefir grains ~ *a culture that turns a milk into kefir*

lactic acid bacteria ~ *bacteria that produce lactic acid*

lacto fermentation ~ *fermentation primarily by lactic acid bacteria*

microbiome ~ *the colony of bacteria that lives in an organism*

phyto -chemicals ~ *plant compounds*

prebiotics ~ f*ood for beneficial bacteria in the gut*

probiotics ~ *live bacteria which add beneficial bacteria to the gut*

substrate ~ *the material being modified by fermentation*

wild fermentation ~ *a ferment from organisms on the substrate or in the air*

yogurt ~ *a fermented milk product*

Resources

Equipment

Kilner fermentation set & kilner jars
www.kilnerjar.co.uk

1/2 gallon fermenting jar with sterilock air lock
www.happykombucha.co.uk

5 litre ceramic fermenting crock
www.bakerybits.co.uk/ceramic-fermenting-jar

yogurt thermometer
www.thermometersuperstore.co.uk

Ingredients
kefir grains
www.happykombucha.co.uk/collections/all-kefir-grains-and-kits

Himalayan pink salt
www.buywholefoodsonline.co.uk/himalayan-rose-pink-salt-fine.html

Books
Fermenting - Daphne Lambert;
Flame Tree Publishing
The Art of Fermentation - Sandor Katz;
Chelsea Green Publishing
Noma Guide to Fermentation – Rene Redzepi, David Zilber;
Artisan
Video
www.youtube.com/watch?v=aG-OTy9iDm4

Greencuisine Trust

Through inspiring projects, courses and consultancy Greencuisine Trust encourages ways of growing and eating that nourish people without harming the environment.

Everyday we make decisions about the food we eat. These choices shape our world and influence not only our individual health but also the wellbeing of all with whom we share planet earth

The Trust is part of a global food movement driving change in our food systems. We believe that through the widespread sharing of both indigenous & scientific knowledge we can maintain the integrity of the planet and all eat nutritious food.

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