Katsuobushi

Nampla

Tea

Makgeolli

Tofuyo

Cider

Kimchi

Narezushi

Takuan

Vinegar

Natto

Soy Sauce

DELICIOUSLY MICROORGANIC

An Illustrated Guide to the World of Fermentation

ferment books
& ono misa

PIE

Discover the Wonderful World of Fermented Food & Drink

DELICIOUSLY MICROORGANIC

An Illustrated Guide

Bread

Beer

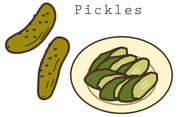
Sake

Coffee

Sausages

Miso

Pickles



Yogurt

Cheese

Butter

Sauerkraut

Wine

by ferment books & ono misa

Discover the Wonderful World of Fermented Food & Drink

DELICIOUSLY MICROORGANIC

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CONTENTS

About the fermentation recipes appearing in this book:
Fermentation involves changes in food ingredients over time, but problems such as abnormal flavor and bacterial growth are possible, depending on the fermentation environment, handling and storage conditions. If you sense that something is off, please discard it, consult a doctor, and handle at your own risk. Please also note that certain fermented foods may be unsuitable, depending on your health condition.

Article Credits:
ferment books: Chapter 0, 1, 4, 5, 7
Ono Misa: Chapters 2, 3, 6

Introduction

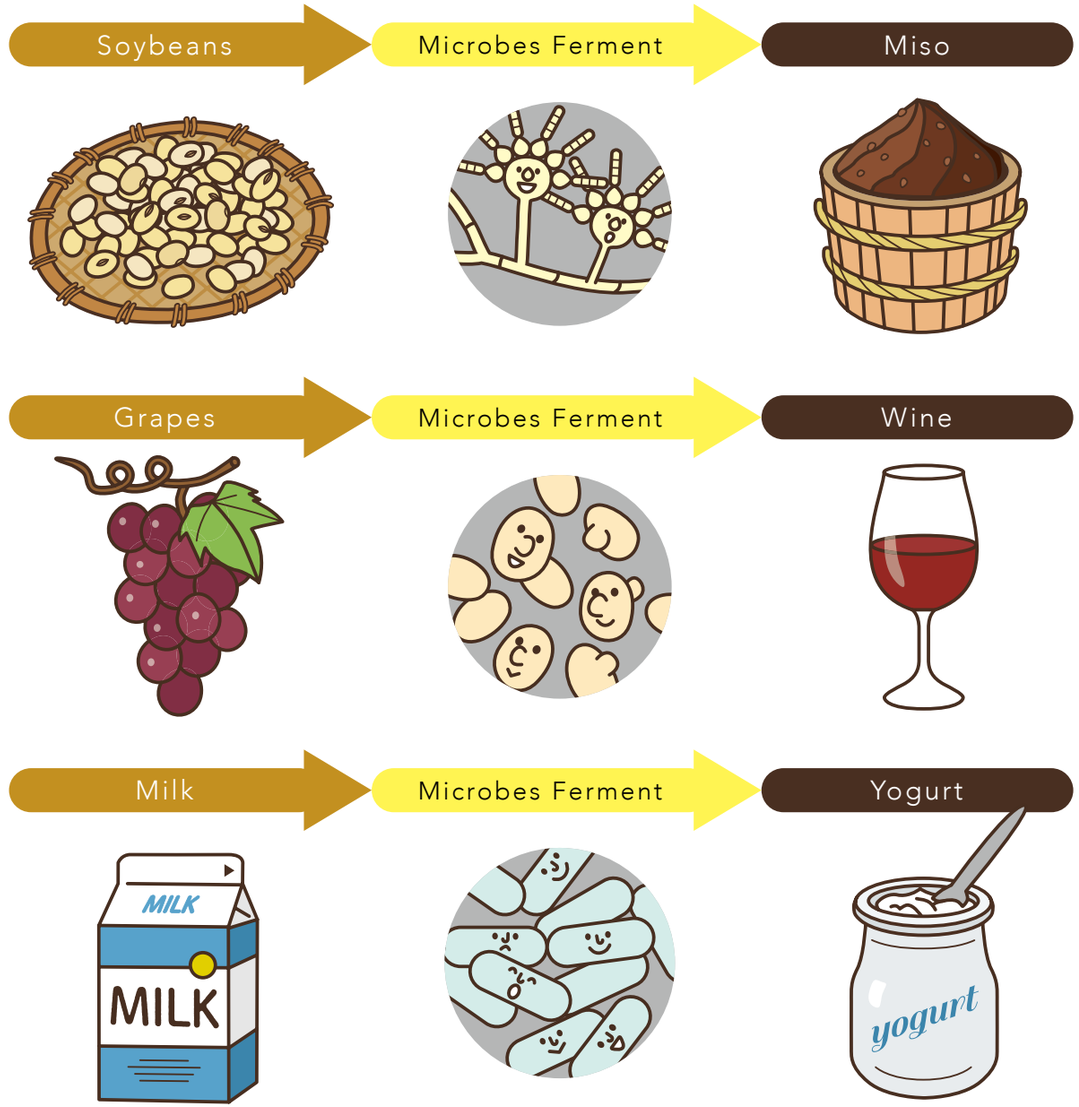
WHAT IS FERMENTATION?

Takeo Koizumi, the leading scientist in fermented food research in Japan, describes the process of fermentation at the beginning of his book ***Fermentation*** like this:

> Microorganisms such as bacteria, yeasts, mold and algae (or the enzymes they produce) act on organic or inorganic substances to produce organic compounds such as methane, alcohol and organic acids, and also inorganic compounds such as carbon dioxide gas, hydrogen, ammonia and hydrogen sulfide, and yet the process is beneficial to humans.

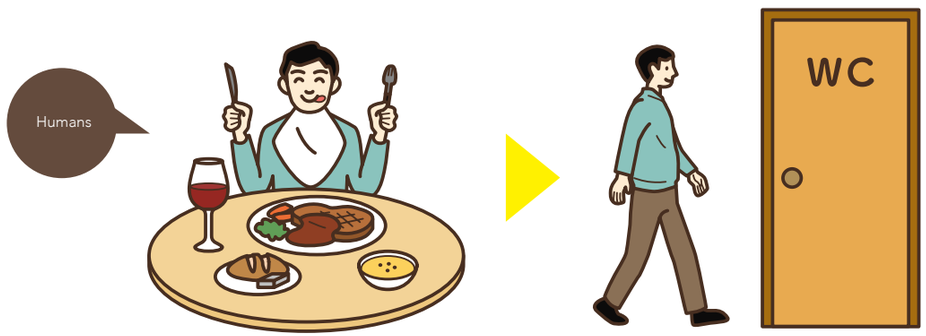
A QUICK LOOK AT FERMENTATION

A range of microorganic food & drink can be made by microorganisms through fermentation.

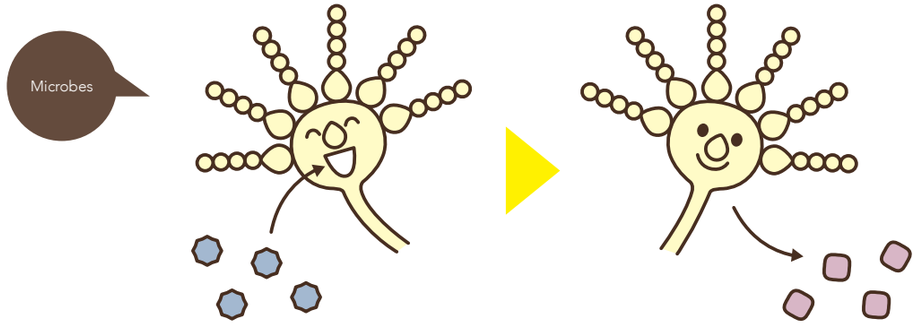


WHAT ARE MICROORGANISMS?

- Microorganisms (also known as microbes) are too small to be seen with the naked eye. They are usually about 1μm to 100μm. 1μm is 1/1000 of 1mm.
- But microorganisms are living creatures just like humans.
- All living things need energy to live and reproduce. To do this, they must take something in and release something else.

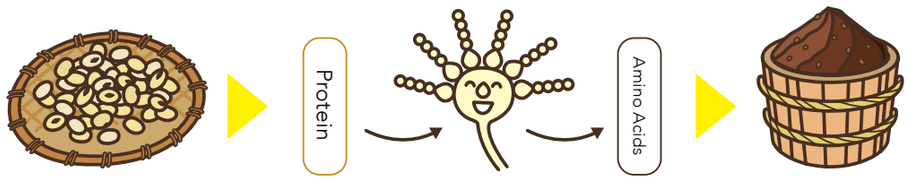


Humans eat food, digest it, gain energy, and release waste as stool and urine.

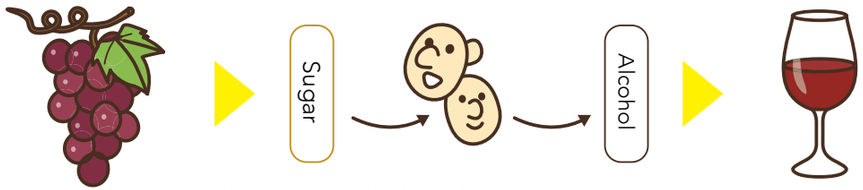


Microorganisms also break down some substances to get energy to create something else.

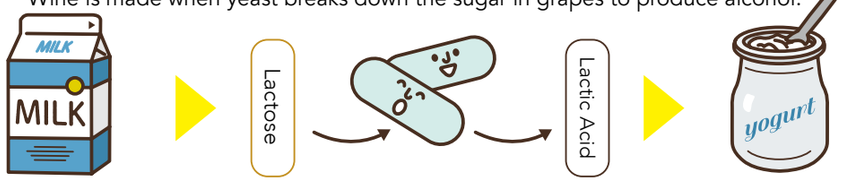
EXAMPLES OF MICROBES



Miso can be made when koji mold breaks down soybean proteins to produces amino acids.



Wine is made when yeast breaks down the sugar in grapes to produce alcohol.



Lactobacillus, a type of bacteria, breaks down lactose in milk, producing lactic acid to make yogurt.

In other words, microorganisms break down substances,

and the process of creating something else is the basis of fermentation.

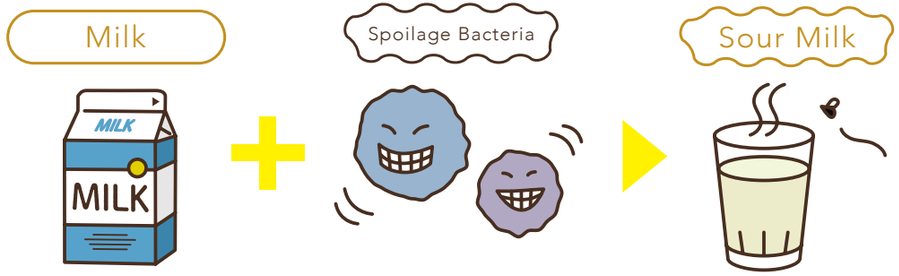
FERMENTATION'S "BIG THREE":

MOLD, YEAST & BACTERIA

	Mold	Yeast	Bacteria
Type	Aspergillus, Rhizopus, Mucor, Blue Mold, White Mold, etc.	Saccharomyces (Baker's yeast, wine yeast, sake yeast, etc.)	Lactic acid bacteria (Lactobacillus), natto bacteria, acetic acid bacteria, etc.
Size	2 to 10 μm	5 to 8 μm	0.5 to 5 μm

BUT...

It's also the work of microbes when food spoils.



JUST AS...

Animals and insects can be grouped by whether they are helpful or harmful to humans...

Helpful

For example:

Dogs

Dogs are companions for humans...

Harmful

For example:

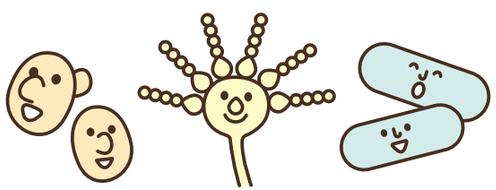
Mosquitoes

But mosquitoes cause itchy bites, and they can also cause malaria and other diseases in humans.

MICROORGANISMS CAN BE...

Helpful Microorganisms for Fermentation

Some microbial activities are good for flavor, preserving, and also for human health.



Harmful Spoilage Microbes

Harmful microorganisms can cause spoilage and food poisoning in humans.

CULTURAL DIFFERENCES

For Inuit people, *kiviak* (see p 64), in which auks (sea swallows) are packed inside a seal's stomach and buried for to ferment, is an important microorganic food that is delicious and healthy. But this food culture might be surprising for Japanese people.

Fermentation & The Adventurer

Naoki Uemura, the Japanese adventurer who encountered many world cultures, loved kiviak. Fermentation researcher Takeo Koizumi was inspired by Uemura to become a "food adventurer" and continues to study food from all over the world.

Natto is a must for some Japanese people, but to others who have never eaten it, natto seems like the soybeans have just gone bad.

How distinctions between

fermentation microorganisms & spoilage microbes

are drawn is also influenced by cultural differences.

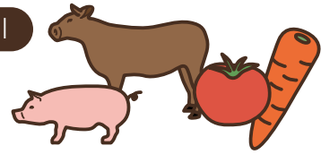
WILD OR AGRICULTURAL?

WILD

Wild organisms used in cooking include wild game, fish and plants.

Agricultural

- Livestock
- Farm-raised fish
- Agricultural crops (grains, produce)



Just as there are two categories of organism used as food for humans...

There are two types of microorganisms

Natural Microbes

Sauerkraut

Wild microorganisms found on cabbage leaves drive fermentation to produce sauerkraut.

Vin nature

Vin nature is "natural wine" that is fermented without wine yeast, using only naturally occuring microbes found on grape skins.

Human-cultivated Microbes

Yeast

Yeast is artificially selected, industrially cultivated and packaged as a product. Yeast for use in making beer, wine, and bread are sold.

Japanese Koji

Koji (Aspergillus oryzae) has long been used to make sake and other fermented food and drink. Sometimes people call it a "domesticated microorganism" in Japan.

Chapter 1

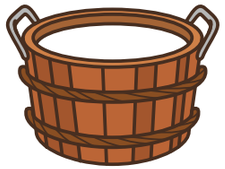
Wine, beer bread, cheese, yogurt...even chocolate is fermented.
Here we introduce essential fermented food and drink from
food cultures around the world.

Let's explore the wonderful world of microorganic food & drink!

CULTURED MILK

What are milk cultures?

Milk cultures can be made through fermentation of lactic acid bacteria, yeast, and mold.

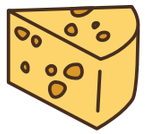


Milk

From goats, sheep, cows, horses, camels, yaks, and other animals.

Fermentation enzymes activate

Fermented Butter



Cheese

Milk Wine

(p28-29)

Lactic Acid Bacteria Drinks

Yogurt

(p45)

p26-27

The Birth of Fermented Milk—the World's Oldest Fermented Food?!

Fermented milk is thought to have been created by the chance mixing of microorganisms with expressed milk. Human cattle breeding began in 10000BCE–8000BCE. Could it have existed since then?

Fermentation in Ancient History

5500BCE

Relics relating to cheesemaking from around 5500BCE have been found in Poland.

4000BCE~3000BCE

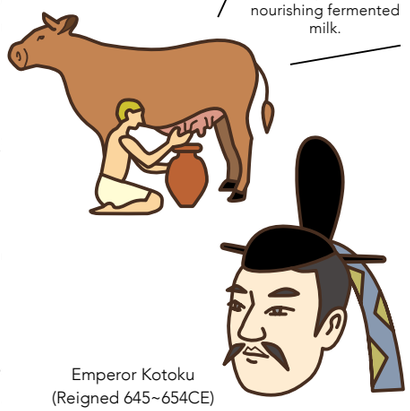
Cheese and other manufacturing methods are drawn on Ancient Egyptian murals around 4000BCE.

3000BC~2000BCE

Even in India, a song singing the praises of cheese appeared in the "Baedal Anthems" around 3000BCE. A description of a butter-like dish was recorded in an Indian scripture around 2000BCE.

36BCE

Cheesemaking was an important industry in the Roman Empire. Detailed production methods are first recorded.



It's easy to make nourishing fermented milk.

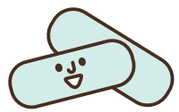
Emperor Kotoku (Reigned 645~654CE)

In Japan, around 645CE, Ambassador Zena from the Baekje kingdoms, introduced milk, dairy, and Su (yogurt and cheese-like, respectively) to Emperor Kotoku, which marks the beginning of fermented milk culture in Japan.

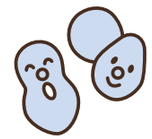
What is lactic acid bacteria?

"Lactic acid bacteria" is a general term for bacteria that produce lactic acid by consuming carbohydrates, such as sugar. Around 400 different types of lactic acid bacteria have been found living naturally all over the world.

Common lactic acid bacteria used in making milk cultures

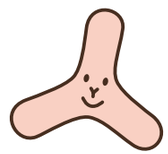


Lactobacillus



Lactococcus

Leuconostoc



Bifidobacterium

	Lactobacillus	Lactococcus	Leuconostoc	Bifidobacterium
Yogurt	○	○	○	○
Cheese	○	○	○	
Lactic Acid Bacteria Drinks	○	○		○
Butter		○	○	

Fermented Butter

Appearing in Indian scriptures around 2000BC, butter has a long history. Butter is the fat content of milk extracted by churning and separating it. In the past, there was no technology to stop the fermentation of milk, and so fermented butter was the only kind available. Now that such technology exists, non-fermented butter has since become the norm in Japan today.

Fermented Butter Around the World

Makhan (India)

Traditionally, makhan refers to the butter obtained by churning dahi (yogurt) made by heating and fermenting raw milk.

Churning dahi separates the liquid from the solid parts.

The liquid is buttermilk, which was originally what lassi were made from.

The buttermilk is heated again and the solid part leftover is called paneer.

The solids are a fermented butter called makhan.

Heating makhan to clarify it makes ghee.

So many different milk cultures can be made by fermenting milk. Similar uses are found all over the world!

Europe

Fermented butter is still mainstream even today.

Tereyağı (Turkey)

Tereyağı is made by stirring yogurt made from milk such as cow, goat, sheep and buffalo.

Yak Butter (Bhutan)

Made from fermented cow or yak milk, this is a key ingredient in butter tea, a Bhutanese favorite..

▶ Try making your own fermented butter! (See "Sour Cream" on p158.)

Chapter 2

JAPANESE MICROORGANIC FOODS

Japan is a major producer of microorganic foods,
from familiar fermented favorites such as sake, miso, soy sauce, dried bonito flakes, to
local delicacies like goishicha, kanzuri and pickled fugu (pufferfish) roe.

SAKE: "NIHON-SHU"

There are many different ethnic groups in the world, and many of them have brewed alcoholic beverages that are unique to their particular culture. For example, Japan has been brewing an alcoholic beverage called "Nihon-shu," through trial and error, since primitive times. Nihon-shu, better known outside of Japan as "sake," has unique and distinctive flavors, even though it is made using just a few very simple ingredients: rice, koji-kin (Aspergillus oryzae) and water. The range of flavor found in sake is a product of "the ingenuity of Japanese people, both present and past."

Steaming

Making Koji

Making Shubo

Making Moromi (Fermentation)

Joso (Pressing)

Filtration

Pasteurization

Maturation

Adding Alcohol

Bottling / Shipping

Three Steps of Sake Brewing

The diagram at left shows the general flow of the brewing and fermentation processes. These can be divided into three main steps: 1) producing koji (koji-kin with added rice); 2) producing shubo/moto (yeast starter); and 3) producing moromi (the main fermenting mash).

With so few ingredients, each brewery uses many inventive ideas and techniques to achieve their unique flavor. In this section, we'll look at the basics of the sake brewing process.

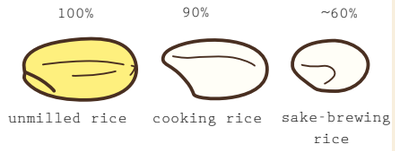
Step 1 MAKING KOJI

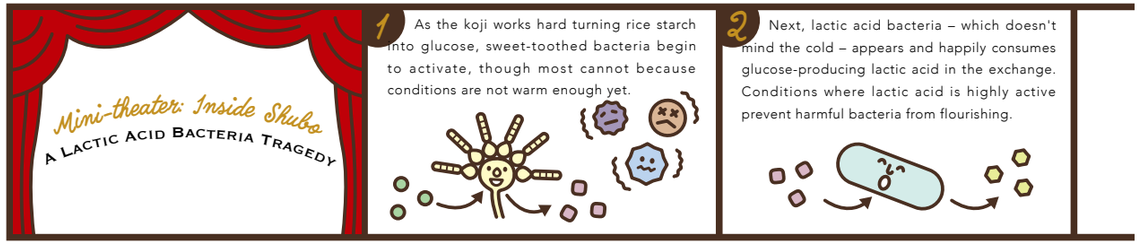
The rice used in brewing sake, called "shuzo koteki mai," is slightly different from that used in cooking. The grains are larger and an opaque white part – called "shinpaku" – is visible at the center of each grain. The more "shinpaku" in the grain, the purer the taste of the sake. So the rice grains are polished to remove their exterior while leaving as much of the actual shinpaku in the grain as possible.

The more polished the rice, the smaller the grain becomes, so controlling temperature and humidity when steaming and producing koji becomes a more sensitive task. There are differences depending on the brewery of course. Some use unmilled rice while others use cooking rice in their brewing process.

Koji for sake making is divided into two types: "sohaze type" (used to make Junmai-shu), in which the koji-kin spores germinate and hyphae covers the surface of each grain, and "tsukihaze type" (used to make Daiginjo-shu) in which the koji-kin spores sporadically germinate on the rice grain surface and its hyphae actually penetrates the grain. Each brewery uses different "haze" methods to control the growth of koji-kin hyphae on the grain depending on the type of sake they wish to produce.

Traditionally, "kikoji" is the most popular koji-kin in sake brewing. Although, it should be noted that "shirokoji" and "kurokoji" – used to make Shochu and Awamori respectively – have recently begun to be used in sake brewing.





Step 2 MAKING SHUBO

Once the koji has been prepared the next step is to make shubo, which is the starter for sake brewing. The Japanese characters for "shubo" literally mean "mother of sake."

Attempting to brew sake by simply placing a bunch of koji, steamed rice, and water in a large tank might result in unwanted bacteria growth, which is very unlikely to succeed in creating the fine sake taste we are after.

To avoid this, brewers should first be sure to use a small tank that is dedicated to shubo making. This will help produce shubo that is packed with lactic acid and yeast, leaving no room for unwanted bacterial growth. Shubo is also called "moto" and has two main types:"kimoto" (yamahai yeast starter) and "sokujomoto" (quick- fermenting starter).

Making Kimoto & Yamahai

The best conditions to make kimoto and yamahai under are cold temperatures, like those on winter mornings. Workers pour cold water and koji into a small tub called a "hangiri" and stir, then add cool steamed rice and stir again. When the koji and steamed rice have absorbed enough liquid, workers will begin to mash the koji and steamed rice using kai (a stirring pole resembling a paddle) while singing work songs.

During mashing, koji enzymes convert rice starch into glucose. The glucose draws out the natural lactic acid bacteria and yeast that lives in the brewery and this is how the complex taste of sake is produced. The work song energizes the workers, serves a timer, and sets the rhythm so the speed at which the kai stirs the mixture can be adjusted. This mashing (motosuri) is popularly called "yamaoroshi."

Adding some finished motosuri mixture to a larger tub and gradually raising the temperature using a hot water bottle called a "dakidaru" will stimulate the koji and promote growth, which increases the sweetness of the shubo. In addition to no unwanted bacteria growth, due to the lactic acid, there will also be an abundant supply of glucose and a comfortable temperature. This is an ideal environment for yeast to do its work, actively turning glucose into alcohol and carbon dioxide. Bubbling, caused by carbon dioxide from the active yeast, is called "wakitsuki."

About three days after the mixture has reached the "wakitsuki" stage, sweetness will decrease and the acidity and spiciness of the alcohol will increase. Once the shubo has matured, the preparation is complete. On average, it takes about a month to finish making shubo. Sake brewed from shubo – produced by the yamaoroshi mashing process – is labeled as "kimotozukuri" and it has a full-bodied, prominently acidic taste.

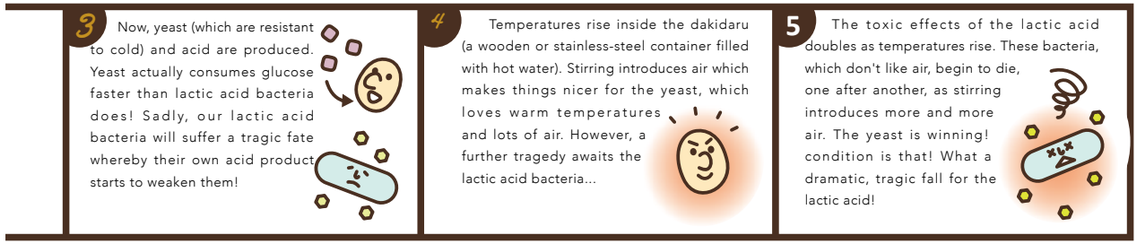
A MOTO-MAKING WORK SONG ♪

Torori torori to ima suru moto wa sake ni tsukurite Edo e dasu.

The thick, thick moto we make now will make the sake we send to Edo.

Making Sokujomoto

For sokujomotozukuri, begin by making moto. Pour koji, steamed rice and water into a small shubo-making tank. Then, add lactic acid bacteria and artificially-cultivated yeast. It takes about fourteen days to produce the moto. This method produces low alcohol and no unwanted bacteria, but has strong acidity and a well-balanced taste. Recently, making sokujomoto has become a popular method for brewing sake. Some breweries blend kimoto and sokujomoto. They also sometimes use artificially-cultivated yeast to produce kimoto. Most of the added yeast is called "Kyokai Yeast" and is distributed by the Japan Brewing Association. The taste of the sake is influenced by the added yeast, even if the same rice is used, which different yeasts producing a range of flavors from basic sake flavor to those with frutier aromas. Some breweries prefer to use their original yeast to brew sake.



AKUMOCHI-ZAKE

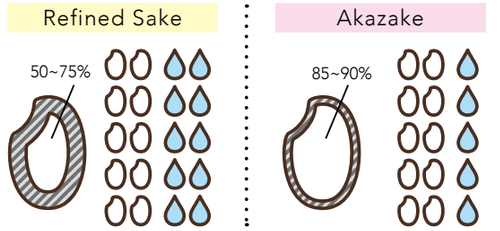
What is Akumochi-zake?

In general brewing of refined sake, pasteurization extends the shelf life of the sake and deactivates the bacteria that are still present from the fermentation phase. This pasteurized sake is called “Himochizake.” Before the invention of the refrigerator, charcoal was added to sake to prevent acidification in the warm regions of Japan. Sake produced with this method is called “Akumochi-zake” and it was the predominant sake before refrigeration. Interestingly, Akumochi-zake has a longer shelf life than Himochizake.

What are the Ingredients?

Refined sake uses rice with a polish rate (seimai-buai) of between fifty- and seventy-five percent. Akazake produced in Kumamoto Prefecture uses rice whose polish rate ranges from eighty-five to ninety percent, which is actually close to regular cooking rice. Refined sake uses ten-koku* rice and ten-koku water which is expressed colloquially as “to mizu” (“ten water”). Akazake uses only five-koku*1 water for ten-koku *1 rice, known colloquially as “go mizu” (“five water”). Akazake uses much more rice than water, resulting in a sake that is so sweet you don’t need any snacks with it.

*one koku = about 180 liters



Major Akumochi-zake Types

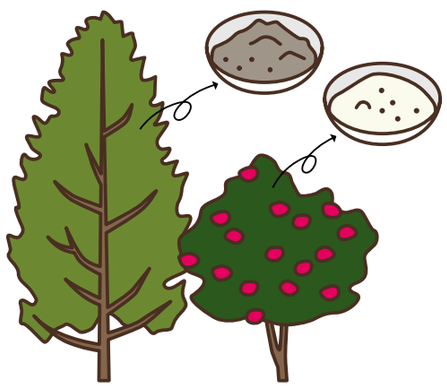
Kumamoto Prefecture……Akazake
(for drinking & cooking)

Shimane Prefecture (Izumo)……Jidenshu

Kagoshima Prefecture……Jizake (micro-brewery sake)

What Kind of Charcoal is Used?

Akumochizake uses food-grade charcoal that is specially made from white cedar and camellia. Long ago, a famous charcoal maker named Kurobe Haiya produced charcoal medicine that was said to be effective at enhancing sake’s power and taste, eliminating bad illnesses, and supporting mental health.

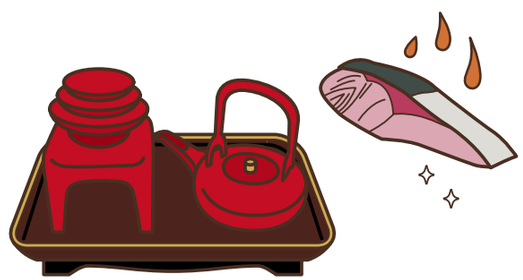


History of Akumochi-zake

The Engishiki (“Procedures of the Engi Era”), compiled in 927, during the middle of Japan's Heian period (794 – 1185CE), describes Shiroki and Kuroki sake. It states that “Kuroki is a pressed fluid resulting from adding wooden charcoal, called Kusaki, to the moromi of Shiroki.” From this statement, Shiroki is thought to be Dakushu/Doburoku (unrefined sake) and Kuroki is Akumochi-zake.

How to enjoy Akumochi-zake

- ▷ On New Year's Eve, allow Tososan (a Japanese herb blend) to soak overnight in Akumochi-zake, or in equal parts Akumochizake and refined sake. Then drink the herb-infused sake on New Year's Day.
- ▷ In cooking, Akumochi-zake is used as a substitute for mirin (sweetened cooking sake). Since charcoal has been added, the composition of the Akumochi-zake changes from acidic to slightly alkaline. This means that it can tenderize meat and fish. Also, any ingredients cooked with Akumochi-zake will have a lustrous look. This is a well-known fact among chefs all around Japan.
- ▷ In Kagoshima Prefecture, there is a type of sushi called “sake-zushi,” which is eaten after pouring locally-brewed Akumochi-zake over it.

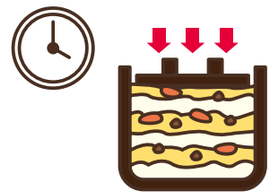


How to Make “Sake-zushi”

1) ***Season all ingredients prior to cooking and set aside.*** Ingredients may include: satsumaage (deep-fried fish putty), kamaboko (steamed fish paste), dried mushrooms (rehydrated before cooking), cloud ear mushrooms, edible wild plants, mitsuba (Japanese parsley), kinshi-tamago (very thin omelets cut into very narrow strips)and seafood.

2) ***Pour generous amounts of seasoned Akumochi-zake over cooked rice and the ingredients listed above, which have been set aside in a separate bowl.***

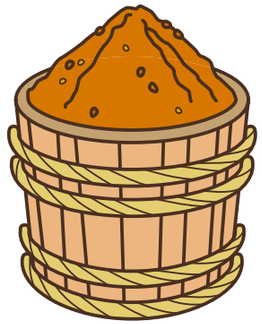
3) ***Layer the rice and the ingredients above alternately in a container. Put a lid on the container and press with a weight. Let sit for four to five hours.***



4) ***After removing the weight and the lid, put some seafood and kinshi-tamago on top.*** Serve with Akumochi-zake from a tokkuri (sake bottle). Add Akumochi-zake if you prefer your sake-zushi to be stronger.

MISO

Miso soup has been a staple in Japanese dining since ancient times, though fewer Japanese people actually keep it in their refrigerators at home thank you might expect. When you order a meal in a cafeteria, it is usually served with a fine miso soup that makes you feel at ease when you drink it. Miso is a superb soup that warms your body, conditions your stomach and helps you purge toxins and chemicals from your body. Even a hangover can be alleviated by drinking miso soup the following morning because miso helps you quickly excrete the alcohol from your system. When you purchase miso, it is recommended that you pick live miso, which has small holes in the packaging, even though it requires refrigeration. This will allow the koji to breathe.



History of Miso

Miso is thought to have originated either in Japan, or to have been brought in from China or Korea. The theory of Japanese origin comes from the discovery of "Jomon miso," which was made from acorns during the Jomon period (14,000 – 300 BCE). This is considered to be the root of native miso production. On the other hand, the theory by which miso was brought in from elsewhere says that ancient Chinese "hisio" (a fermented meat, fish, and salt mixture) and "kuki" (a fermented soybean and salt mixture) were brought to Japan from Mainland China and the Korean Peninsula, and that became the miso we know.

The name miso appears in the Taiho Ritsuryo (Taiho Code), published in Taiho gannen (701CE), as the word,"misho," meaning "a solid mass that is one step from becoming soy sauce."

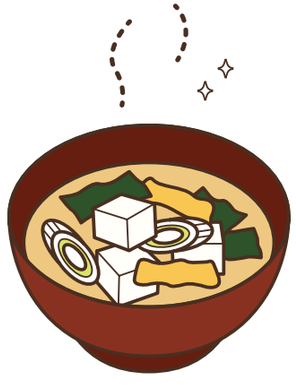
That is why it has been said that the word miso is derived from misho. According to the Engishiki ("Procedures of the Engi Era"), the salaries of senior bureaucrats in the Heian period (794 – 1192CE) were paid with miso, and/or glutinous rice, instead of money. Back then, miso must has been quite the luxury item! However, after a couple of centuries, miso soup was finally introduced into commoners' lives in the Muromachi period (1336 – 1573CE).

Benefits of Miso

Miso has always been a valuable source of protein in the Japanese diet. Since fermented miso is rich in essential amino acids, vitamins, and minerals that make up proteins, it has truly been a great nutritional support for the Japanese people. Also, there is a theory that miso helps to prevent cancer and hypertension.

In addition, it also has the function of strengthening the capillaries of the heart and spinal cord. The pigment component that makes up miso's brown color is an antioxidant, so it is also thought it helps prevent the body from aging.

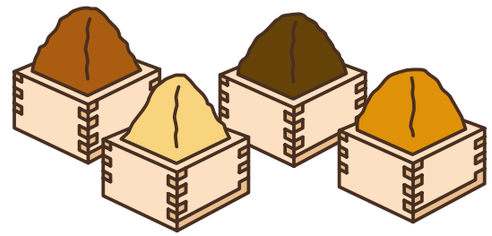
There is about 1.4 g of sodium per bowl of miso soup, which means that it does not exceed the recommended daily salt intake. Most people recommend drinking one bowl a day, being sure to add plenty of vegetables and seaweed.



Types of Miso

Kome-miso (Rice Miso)

Kome-miso is made by mixing soybeans, kome-koji (rice malt), and salt and then allowing the mixture to ferment. Eighty percent of the miso produced in Japan is kome-miso. There are many types of kome-miso that differ based on color (cream colored shiro-miso, pale brown, or brown) and taste (sweet or salty). The length of time the miso is aged, whether the soybeans are steamed or cooked, and the amount of koji used determines the color. The mixing ratio of koji, soybeans, and salt determines the flavor. The more koji is used, the sweeter the miso will be. Shiro-miso uses a greater amount of kome-koji than soybeans, so it produces a sweeter taste and needs only a short aging period.



Mugi-miso (Barley Miso)

Mugi-miso is made by fermenting soybeans with barley and salt. Since this type of miso was originally made as a staple by farmers, it is also called "inaka-miso" ("countryside miso"). It has an earthy flavor and brings a somewhat sentimental feeling to anyone who tastes it. It has a pale and deep color.

Mame-miso (Soybean Miso)

Mame-miso is made by fermenting soybeans, in a starter culture and salt. It is also called aka-miso, hatcho-miso, or tamari-miso. Steam soybeans to make miso-dama (balled soybean mash) and drench miso-dama with starter koji and kosen (roasted barley flour). Then, allow it to ferment. Mame-miso is dark red and has a strong flavor that is tart and acidic.

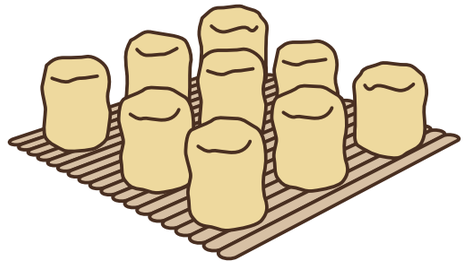
Chogo-miso (Blended Miso)

Chogo-miso is made by blending kome-miso, mugi-miso, or mame-miso. Or, by blending koji – kome-koji or mugi-koji.

Unique Miso

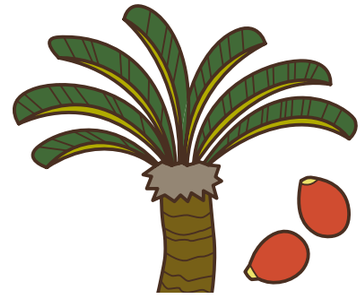
Tamatsukuri-miso

Usually, miso is made by adding salt and kome-koji to cooked soybeans. When making tamatsukuri-miso however, boiled (or steamed) soybeans are mashed to make miso-dama (balled soybean mash) and then allowed to rest in the muro (cellar). Then, fungus living in the muro are allowed to attach to the surface of the miso-dama. There are of course different methods for sprinkling the surface of the miso-dama with koji-kin to make fluffy koji flowers bloom on the exterior. The miso-dama can also be tied with a rope and hung from the ceiling. After that, kome-koji is mixed with salt and age to mature as usual. The complex taste – unlike regular miso – that results is produced by the various fungi.

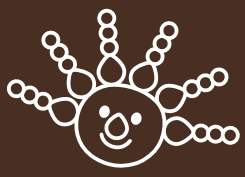


Sotetsu-miso (Sago Palm Seed Miso)

Sotetsu-miso is produced on the island of Amami Oshima in Kagoshima Prefecture and Aguni-jima Island in Okinawa Prefecture. It uses sago palm seeds, brown rice, soybeans, and sweet potatoes. The seeds of the sago palm contain toxic substances that must be removed by soaking them in water and then sun-drying in order to let microorganisms in the air detoxify them. (The seeds can also be buried underground in order to let microorganisms in the soil detoxify them). Sotetsu-koji (sago palm seed malt) is made by fermenting the detoxed sago palm seeds and brown rice with koji-kin. Then, soybeans, sweet potatoes, and salt are added and stored in a jar. The mixture ferments and ages due to sodium- tolerant yeast and lactic acid bacteria. The result is a totally non-toxic, uniquely flavored sotetsu-miso. In Okinawa, Andansu cooked with sotetsu-miso and pork is considered to be the best snack to have with tea.



Chapter 3

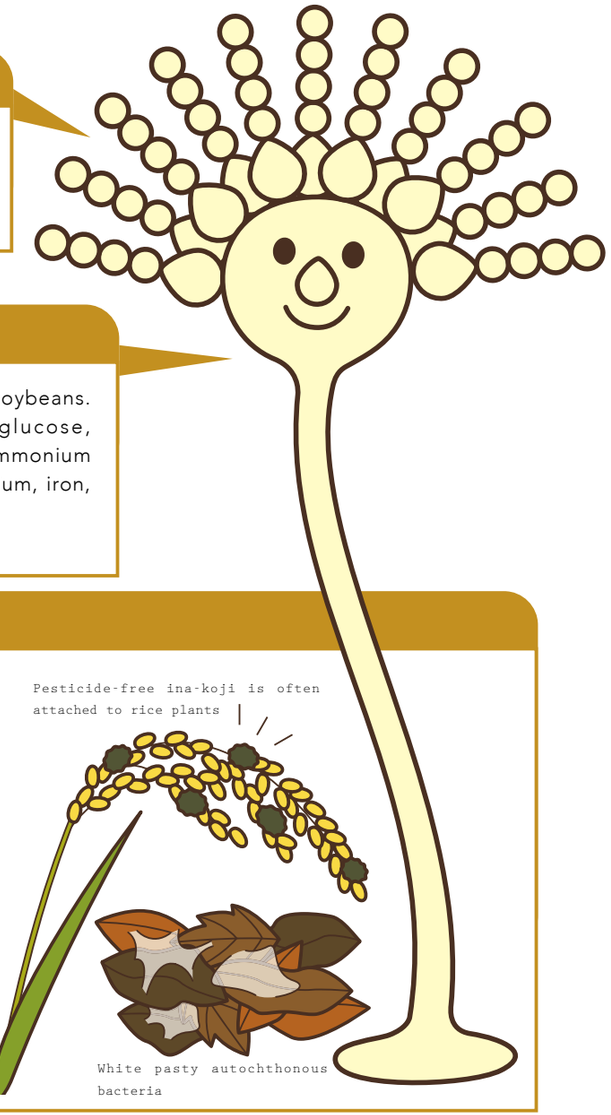


KOJI IS LIKE GOLD

Koji is the key microorganic ingredient in Japanese fermented foods. From Japanese sake (Nihon-shu) to miso and soy sauce, koji is the symbol of Japan's fermentation culture.

KOJI: A PROFILE

Most of the fermented foods produced in Japan use the power of microorganisms such as koji-kin, lactic acid bacteria, yeast, acetic acid bacteria, and natto bacteria. Among them, koji-kin is the most used. The Brewing Society of Japan acknowledges koji as a "kokukin", which means "National Microbe." Why is koji so important in Japan? The more you know about koji, the more you will be convinced of the wonder of these koji microorganisms.



Things Koji Microbes Like

Koji likes water, oxygen and suitable humidity.
Koji tolerates cold temperatures well, and weakens in warm temperatures (35℃ is the ideal temperature).
It prefers a slightly acidic pH.

Preferred Foods

Grains: mainly steamed rice, barley, soybeans.
Nutrition: carbohydrates (starch, glucose, saccharose), nitrogen (amino acids, ammonium sulfate), minerals (phosphorus, potassium, iron, magnesium, and others).

Preferred Conditions

Koji loves the moderately warm and humid climate of Japan. It can be found anywhere in the air, and especially around rice fields and in nature-rich mountains and fields.

On pesticide-free rice plants, a lump-like mold substance called "ina-koji (inadama)" grows. Ina-koji is killed off by pesticides because it is considered a disease called, "inekabi-byo." However, in the past, koji was made by purposefully growing ina-koji on rice. To this day, some sake breweries still make sake using kikoji-kin that is extracted from ina-koji.

You might also find a white pasty substance on fallen leaves in bamboo forests that have begun to decay. This white pasty substance is koji's autochthonous bacteria and the majority is actually kikoji (or "yellow-koji").

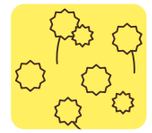
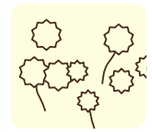
Kikoji is used as organic fertilizer (bokashi) in Japan.

麹 糀 麹

The Name "Koji"

The different kinds of Koji are named based on the plant the microorganism grows on. When koji is grown on rice ("kome"), it is called "kome-koji" (rice malt). When koji is grown on barley ("mugi"), it is called mugi-koji (barley malt). When koji is grown on soybeans ("mame"), it is called mame-koji (soybean malt).

One major form of koji-kin in Japan is kikoji-kin (*Aspergillus oryzae*). It is used in the production of sake and amazake. Shoyu Koji Kabi (*Aspergillus soya ojae*), is used when making soy sauce and miso. Other types of microbes are also actively used. For example, *Aspergillus glaucus* is used for dried bonito. There are *Aspergillus luchuensis mut. kawachii* and *Aspergillus luchuensis* for shochu production, *Aspergillus luchuensis* for Awamori, and *Monascus purpureus* for Tofuyo (fermented tofu). On the right there is a chart that lists the grain, the seeds and the molds associated with koji-kin. Each of the names only refer to the mold color.

	Koji-kin	Seeds	Koji
Kikoji-kin			
Shirokoji-kin			
Kurokoji-kin			

Products Made Using Koji

Koji microbes are used in most Japanese seasonings, such as sake, soy sauce, and miso. Other standard ingredients in Japanese cuisine include rice, glutinous rice, soybeans, barley, salt and others. That koji microbes can be put to such effective and creative use to make such a large number of incredible flavors using such simple ingredients is perhaps why they have been treasured by the Japanese people for so long.

Refined Sake

Kome-koji + Rice + Water

Shochu

Raw ingredients: Rice, Barley or Yam + Koji + Water

Mirin

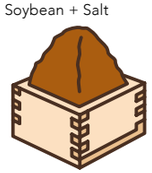
Kome-koji + Glutenous Rice + Rice Shochu

Vinegar

Raw ingredients: Rice, Grains, or Brown Rice + koji and water

Miso

Kome-koji + Soybean + Salt



Soy Sauce

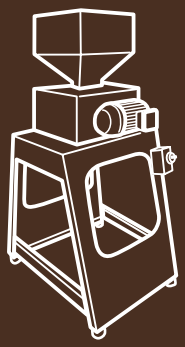
Soybean-koji + Wheat-koji + Salt Water

Amazake

Kome-koji + Rice + Water

Pickled Vegetables

Kome-koji + Salt + Vegetables, etc.



Chapter 4

A LOOK AT WHERE FERMENTATION HAPPENS

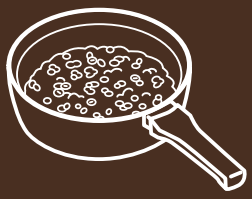
In this chapter, we'll take a look at real-world fermentation by meeting leading creators and producers and seeing where they work. We'll also visit the facilities where miso, beer, wine and nam pla are produced and sold.

Chapter 5

FERMENTATION: A GLOBAL CHRONOLOGY

Billions of years after the birth of microorganisms, the main agents of fermentation, humans appeared on Earth. Humans developed fermentation culture, which they refined into a science.

Chapter 6



MICROORGANIC FOOD & INGREDIENTS

Fermentation is often thought of as something that only specialist brewers and distillers can do, but there are many things you can easily make at home. This chapter offers a collection of delicious fermented food recipes.

Chapter 7

FURTHER READING

Read more about the various cultures, traditions, cuisines, science and history of fermentation.