

# The Story of Sake

1

Featured  
article

## Sake (Seishu)

History.....	1
How is sake made .....	2
Product information .....	6
How to evaluate and enjoy sake.....	8

Sake is a traditional alcoholic beverage in Japan. It is made through fermentation, like beer and wine. Sake is made from rice, a staple food in Japan. It is an integral part of the Japanese lifestyle and culture. In recent years, Japanese cuisine is becoming more popular internationally. Accordingly, increasing number of people enjoy sake, which goes well with Japanese cuisine, all over the world.

The processes and methods of making sake are quite a bit more complicated than those for making wine and beer. Nowadays, though, sake production techniques have been largely clarified by science. The traditional skills of chief sake makers, called *toji*, as well as modern scientific knowledge, have made it possible to produce varieties of high quality sake.



A traditional sake brewery

## History

It is not exactly known just when people began making sake in Japan. However, it is believed that an alcoholic beverage made from rice was already being made in the Yayoi period (300 BC-250 AD) when rice cultivation was brought from China to Japan. It was during the last half of the Nara period (710-794) when the methods of rice growing became stable. A special organization called Sake-no-Tsukasa was established to produce sake for the Imperial Court. During the Heian period (794-1185), sake was made in temples and shrines, as well as among the people. Sake breweries appeared in the Muromachi period (1333-1573). Because of this, the Muromachi Shogunate started charging taxes on sake production, as a source of revenue for the government. In the last half of the 16th century, people started to polish the rice grains for sake making, and to press the fermentation mash to separate the sake. A heat sterilization (pasteurization) process called *hiire* was also invented during that period. By this time, the technique to make large wooden tubs had been developed, which enabled sake breweries to make and store a large volume of sake at one time.

Manufacturing sake became a thriving industry during the Edo period (1603-1868). During that period, they devised a technique to add distilled alcohol to sake in order to adjust the flavor and preserve it from bacterial contamination.

In 1904, the National Research Institute of Brewing was established in the Ministry of Finance. It is a unique national research institute for alcoholic beverages in Japan that conducts scientific research on sake making and develops new technology and techniques for sake making.

From ancient times, sake was regarded as a special beverage made from precious rice. People drank sake on special occasions, such as festivals, marriages, and funerals. Now, we can enjoy sake any day as a tool for communication among people.

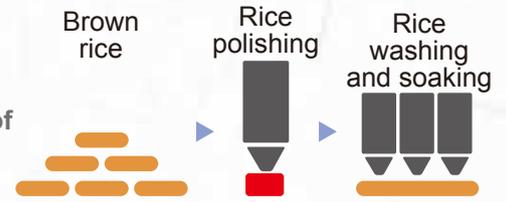


Sakabayashi or Sugidama

Sake breweries used to hang a large ball made of cedar twigs (*Sakabayashi*) at their entrance. This announced that fresh sake was made. When the fresh green needles turned brown, that was the sign that the new sake was ready to drink.

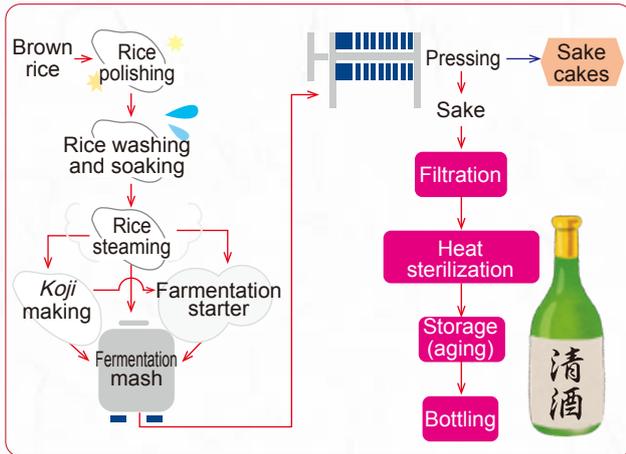
# How is sake made?

The science of sake making



Sake, just like wine and beer, is made through the fermentation of yeast. Fermentation is the process whereby yeast (a kind of microbes) produces alcohol and CO<sub>2</sub> from sugar.

Sake is made from rice, *koji*, and water. Alcohol may also be added. Here is an outline of the process of making sake.



How to make sake

## Rice

Sake is an alcoholic beverage made from rice. There are special varieties of sake rice that are suitable for sake making, called *shuzo-kotekimai*, just as wine is made from wine grapes.



Yamadanishiki, a variety of sake rice



Flowers of Yamadanishiki

Fine polished white rice, not brown rice, is used to make sake. Rice contains protein. The *koji* enzymes break down the protein to amino acids and peptides. These compounds provide *umami* (savory taste). However, if there are too much of amino acids and peptides, then the taste will become too heavy. It is known that the oil in the rice grains prevents the development of a fruity aroma. Therefore, sake breweries polish off the outer layer of the rice grains, the bran, which contains a lot of protein and oil, so that the sake will develop its special aroma. Table rice is polished to remove about 10% of the outer layer. For rice used for sake making, 30% of the grain is polished away, which means that 70% is left. The proportion of rice remaining, not the proportion removed, is called the rice-polishing

rate. In order to obtain 1 kg of white rice with 70% of rice-polishing rate, we need 1.4 kg of brown rice. When making a special refined sake (*daiginjo-shu*), 50% or more of the rice is polished away. Some of the highest-quality *daiginjo-shu* is made from rice with 30% of rice-polishing rate. It may seem wasteful to polish away 70% of the rice. However, rice polishing is one of the most important steps to produce great sake with fine aroma and elegant taste.



Brown rice 70% polishing rate 40% polishing rate

Polishing rice takes 1 to 4 days depending on the rice-polishing rate.



Automated rice-polishing machine. The experience of sake brewers was converted to computerized data to control this machine.

First, the rice bran powder is washed out of the rice. Then, the grain is soaked in water so that it absorbs adequate moisture. Then the rice is steamed. Sake is made during the winter, and the workers in sake breweries have to work in the cold season using cold water. Therefore, washing rice is a very arduous job. The technique for making the grain absorb moisture varies with the rice-polishing rate and variety of rice. The soaked rice is drained and covered with a cloth overnight. The next day, the rice grains are sent to the next step, steaming.



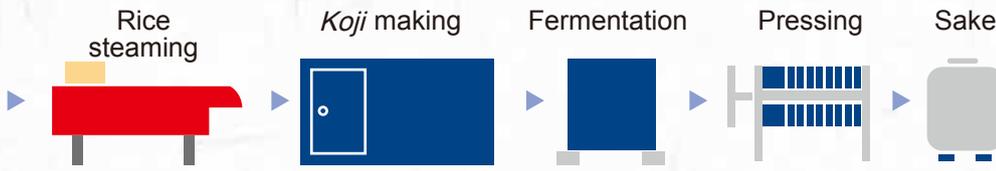
Manual rice washing



An automatic rice washing and soaking machine

Either a traditional steamer or an automatic steamer is used for the steaming process. Steaming, as well as cooking, makes the rice starch easier for the *koji* enzyme to break down. Unlike table rice which are cooked in water, steamed rice is still quite firm. The most important factor to make *koji* and a fermentation mash is to ensure that the steamed rice grains are separated from each other, and not stuck together. Some table rice varieties for eating, such as *Koshihikari*, are sticky and make a thick ball of grain. Therefore, these varieties are not suitable for making sake. Of all the rice that used for sake making, 15 to 25% is used for *koji* making. The rest of rice is steamed and added to a fermentation starter and a fermentation mash.

# The Story of Sake



*Koshiki*  
A traditional steamer



An automatic steamer



Freshly-steamed rice



Steamed rice being cooled and transported automatically on a conveyor belt

The first step in making *koji* is to cool down the steamed rice, and bring it into a *koji* room. Then, the rice is spread out on a long table called *toko*, and spores of *koji* mold are scattered over it. Then, the mass is mixed well so that the spores adhere evenly to the steamed rice. After that, the rice is heaped up and covered with cloth to keep the temperature and humidity of rice constant. The scattered spores germinate and extend their hyphae. During this process, the temperature of *koji* rises from the heat generated by the *koji*'s metabolism. In order to keep a suitable temperature, moisture, and the growth of hyphae uniformly, the *koji* is mixed and the pile is spread out again.



The *toji* (the chief sake maker) scatters *koji* spores onto rice in a *koji*-making room at a temperature approximately 30°C.



Workers are carefully spreading out newly made *koji*.

As time goes by, white areas called *haze* extend across the surfaces of the rice. Approximately two days after the rice is placed in the *koji*-making room, the *koji* making is finished.



1st day

Areas where the hyphae of *koji* mold grow become white.



2nd day

After approximately two days, the *koji* mold completely covers the steamed rice.

The *koji* extends hyphae not only on the rice, but also into the rice grains. While the *koji* mold is growing on the steamed rice, it produces enzymes. Although the enzymes cannot be seen, they have a very important role in the sake making. The enzymes from the *koji* convert the starch in the rice into sugar.

Yeast needs sugar to make alcohol. Starch has longer molecules made of sugar and cannot be directly converted to alcohol by yeast.

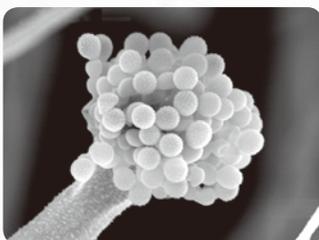
That is, yeast does not have an enzyme to digest starch. When the *koji* is added to the fermentation mash, its enzymes convert the starch to sugar. The yeast can then produce alcohol from that sugar. *Koji* and yeast make a great team!



The *koji* enzymes (as shown in the beaker on the right) convert the starch in steamed rice to sugar, and the fermentation mash becomes liquefied. The left beaker does not contain *koji*.

## Koji

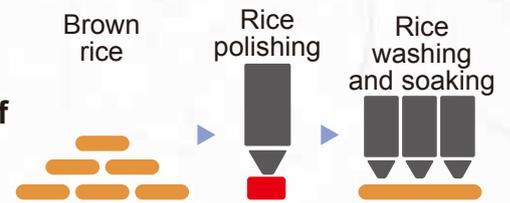
*Koji* mold (a variety of *Aspergillus*) is called the national fungi of Japan. *Koji* is used for making a variety of traditional Japanese foods. Beside sake, *koji* is used to make *shochu* (Japanese liquor), soy sauce, *miso*, and vinegar. Strains of *koji* have been commercialized since the Muromachi period (1333-1573), which is much earlier than yeast strains.



*Koji* spores

# How is sake made?

## The science of sake making



### Water

Water is indispensable for sake making. Sake contains approximately 80% of water.

Besides being used to make a fermentation mash, water is also used to wash and to soak the rice. Sake making needs approximately 10 times as much water as rice. The quality of the water for sake making is very important.

Iron is the most unfavorable mineral in water. If sake contains too much iron, it has a reddish brown color, and its taste and aroma are unpleasant. The iron concentration in water used for sake making must be less than 0.02 ppm, which is lower than water quality standards for tap



Fushimi in Kyoto

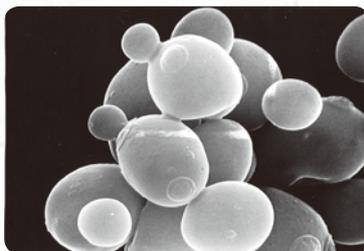
In a shrine in Fushimi, Kyoto, there is a famous spring of excellent water. There are many sake breweries in Fushimi using this wealth of good quality water.

water (0.3 ppm or less). Fortunately, there are many excellent water sources all over Japan that fulfill this requirement. Where excellent water sources exist, you will find many sake breweries, such as at Nada in Kobe and Fushimi in Kyoto. They are designated as among the 100 best water resources by the Ministry of the Environment.

### Yeast

Yeast is used for producing many foods, such as bread and soy sauce. Yeast, which makes alcohol, is very important for sake making.

Where do we find yeasts in nature? Yeast likes sweet things, like fruits and flowers. Many types of yeast grow on the skin of grapes when they are injured. Really, yeast lives almost everywhere, in the sea, mountains, rivers, and soil . . . throughout the nature. Yeast lives on plants, such as rice plants, and also in sake breweries. They are called wild yeast.



Yeast

Before the pure culture method of yeast was developed in the 19th century, sake was made through natural fermentation using wild yeast. Lambic beer and naturally fermented wine are still made with wild yeast, even though it is uncommon for sake making. Some wild yeasts produce unfavorable smells, like paint thinner or vinegar. Wild yeasts usually have low ability to produce alcohol and is not suitable for sake making.

Nowadays, most sake breweries use reliable sake yeast specially selected from wild yeast. Using sake yeast ensures the stable production of high quality sake.

It was 1895 when Dr. Kikuji Yabe isolated sake yeast from a fermentation mash for the first time. Then, the Brewing Society of Japan started distributing this selected sake yeast to sake breweries all over Japan. Different sake yeast strains provide different aromas and tastes. Sake breweries use appropriate yeast strains for their sake.



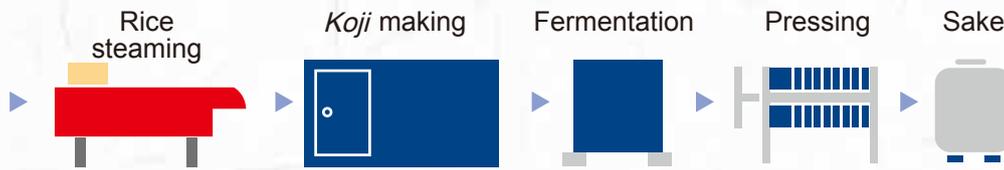
Kyokai yeast (yeast distributed by the Brewing Society of Japan)

### Shubo (Fermentation starter)

In order to cultivate the large amount of yeast required for fermentation mash, fermentation starter is prepared. It is also called *moto* (meaning 'source' in Japanese) as this is the original source of sake fermentation. First, water, *koji*, and steamed rice are put into a tank, and cultured yeast is added. Generally, lactic acid must be added to the fermentation starter. Lactic acid suppresses the growth of harmful bacteria that might produce unpleasant smell and taste. In the case of traditional types of fermentation starter, called *kimoto* or *yamahai*, lactic acid bacteria grow first and produce lactic acid. By skillful management of microorganisms, and careful control of the temperature, we can make fermentation starter a pure culture of yeast. Therefore, fermentation starter is an important process in making delicious sake.



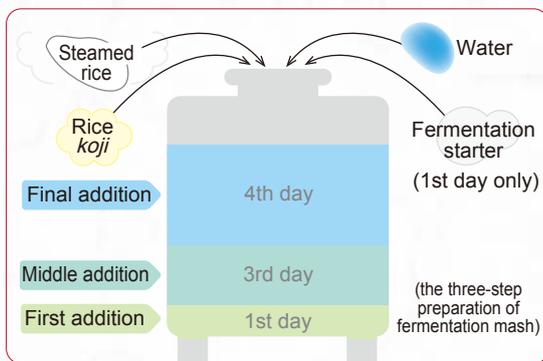
A fermentation starter



## Moromi (Fermentation mash)

Now, the main elements for making sake are ready. Let's make *moromi*, the fermentation mash, by putting the steamed rice, *koji*, water, and fermentation starter into a fermentation tank.

The fermentation mash is prepared through three steps. Each of these materials (except the fermentation starter) is divided into three portions with increasing volume, and a portion of each material is added in sequence. This method is effective to avoid lowering the yeast density and the acid level in the mash and to prevent bacterial contamination.



On the first day, the entire quantity of fermentation starter, 1/6 of the total volume of steamed rice, *koji*, and water are used (the first addition). On the second day, no addition. Little by little yeast will grow. It is called the *odori* stage. On the third day, 1/3 of the steamed rice, *koji*, and water are added (the middle addition). On the fourth day, 1/2 of the steamed rice, *koji*, and water are added (the final addition). After proceeding through the three steps, the fermentation mash is mixed (a process called *kaiire*) every day. The fermentation tank should be kept at a low temperature (about 15°C). After three weeks of fermentation, the alcohol concentration of the fermentation mash will reach 18% and level off.



The fermentation tank, soon after the final addition.

After a week, the fermentation mash is covered with lots of bubbles.



## Pressing the mash, pasteurization, bottling

After the fermentation, the fermentation mash contains sake and a lot of solid substances, such as undissolved rice and *koji*. It is mushy at this point. To obtain sake, the mash is pressed with an automatic filter press or a traditional press called *fune* (because it looks like a *fune* meaning a boat in Japanese). The solid material that is separated out is called *sake kasu* (sake cake). After this pressing process, we have new sake with a pleasant aroma.



Automatic filter press for sake



Fune, a traditional press for sake



The mash is poured into bags, and the bags are laid in a traditional press

Generally, new sake is pasteurized in a process called *hiire* (heat sterilization). The purpose of heat sterilization is to kill bacteria that deteriorate sake during storage and to prevent further enzymatic reaction. After heat sterilization, sake is stored for a certain period. Then it is bottled and shipped.

# Product information

You will be a sake connoisseur after reading these pages.



Rika, a housewife, comes into a liquor shop to buy some sake.



Owner: Hello! May I help you?

Rika: I'd like a bottle of sake.

Owner: We have many types of sake. Which one would you like?

Rika: To tell the truth, I don't know which one I should buy. Please tell me about sake.

Owner: OK. I'd be happy to. First of all, let me explain the various types of sake to you. According to the materials used and the rice-polishing rate, sake is roughly classified into 4 categories: *Ginjo-shu*, *Junmai-shu*, *Honjozo-shu*, and ordinary sake. The raw materials for making sake, beside rice, include alcohol, saccharides, and acidulant. *Junmai-shu* is sake made from only rice, without addition of alcohol or other ingredients.

Rika: You mean *Junmai-shu* is made from 100% rice? How does *Junmai-shu* taste?

Owner: *Junmai-shu* is full of the taste that comes from rice, and it tastes rich. See the label? It shows that it is made from rice and *koji*.

Rika: It sounds delicious.

Owner: *Honjozo-shu* is made from rice, *koji*, and a little bit of brewers alcohol. To make *Junmai-shu*, the mash is pressed after the fermentation. On the other hand, to make *Honjozo-shu*, a little brewers alcohol is added before pressing.

Rika: Why do they add brewers alcohol?

Owner: In the Edo period (1603-1868), sake breweries found that adding *shochu* (Japanese liquor) made by distilling sake cakes to the sake improves its flavor. It was an important technique (*Hasira-shochu*) during that period. We have inherited this method and utilized it to make *Honjozo-shu*. Now, distilled pure alcohol (brewers alcohol) is used instead of *shochu*.



Rika: What is that brewers alcohol made from?

Owner: It's not like the alcohol made by chemical means used for sterilization. Brewers alcohol for sake making is made by fermentation of raw materials such as sugar cane (molasses) using yeast. So it is called *jozo* (fermented)-alcohol in Japanese.

Rika: How much brewers alcohol is added?

Owner: To make *honjozo-shu*, the equivalent of up to 10% of the weight of the rice used for sake making can be added. From 1,000 kg of rice, approximately 2,400 liters of *Junmai-shu* or approximately 3,000 liters of *honjozo-shu* are made.



Rika: How will the flavor of the sake change after brewers alcohol is added?

Owner: Sake will be less acidic, and its taste will become light and dry.

Rika: What does *honjozo-shu* taste like?

Owner: It has a good balance of tastes and flavors derived from rice. We recommend *honjozo-shu* for everyone, from beginners to sake connoisseurs. The label shows that it is made from rice, *koji*, and brewers alcohol.



Rika: It will be tasty and easy to drink.

Owner: The largest amount of sake produced is ordinary sake. Simply put, this is sake that is pressed out after a bit more alcohol is added than that is used for *honjozo-shu*. The label shows that it is made of rice, *koji*, and alcohol. For ordinary sake, it is allowed to use saccharides and acidulant. Saccharides and acidulant will appear on the label when they are used.

Rika: What does ordinary sake taste like?

Owner: It tastes a little sweet, light and smooth. Some ordinary sakes are packed in cartons.

Rika: So it sounds like it's for casual drinking.

Owner: *Ginjo-shu* is made by a special method using highly polished rice. Since *ginjo-shu* needs a lot of care and production cost, only a little is produced. A little of alcohol is added during the process of some *ginjo-shu*. Alcohol is effective to adjust the taste. It also has the effect of extracting the fruity aroma that tends to be absorbed by yeast and rice grains into the sake.

Rika: What does *ginjo-shu* taste like?

Owner: It has the fruity aroma of apples, melons, or bananas, and a mild taste. During the production of *ginjo-shu*, the chief sake maker concentrate so hard on making *ginjo-shu*. *Ginjo-shu* is often exhibited at sake competitions all over Japan.



Rika: I would like to taste it!

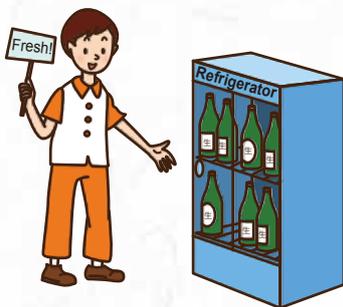
Owner: *Ginjo-shu* is expensive, but it is worth the price.

Rika: How is sake treated after the pressing?

Owner: The flavor of sake is easily changed by enzyme reaction. So, sake is heated to approximately 65°C to stop the enzymatic reaction. This process has the effect of heat sterilization, too. After it is heat treated, the sake is generally stored over the summer for aging, and shipping starts in the beginning of autumn. The stored sake contains approximately 20% alcohol. Before bottling, it will be diluted with water to reduce the alcohol concentration to approximately 15%. Sake will be sterilized by heating again just before bottling.

Rika: Is there any sake that is not heated?

Owner: Yes, there is. A sake that is not heated at all is called *nama-zake* (*nama* means raw). *Nama-zake* retains its just-pressed fresh flavor if it is stored in a refrigerator. Sake that is stored without heat treatment, and then heated just before bottling is called *namachozo-shu*. *Nama-zake* and *namachozo-shu* are indicated on their labels. Sakes without indication of *nama-zake* or *namachozo-shu* on their labels have been heat treated two times, once before storing and once before bottling.

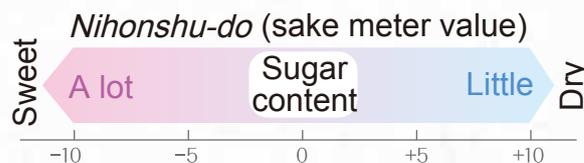


Rika: Why is alcohol in sake diluted before bottling?

Owner: An alcohol content of 20% is generally too strong. Some sake is not diluted. In this case, it is labeled as

*genshu*.

Rika: How can I tell if a sake is sweet or dry?



Owner: Sweet or dry on the label is a useful indication. Some sake shows its *nihonshu-do* (sake meter value) on the back label. Sake meter value is a kind of unit of density, and generally it expresses the amount of sugar contained in sake. Sake on the market ranges in sake meter value from +10 to -10. The higher the number, the lower the sugar content. If you like a sweet sake, choose one with a minus value. If you want a dry sake, select one with a plus sake meter value. However, the acidity of sake influences its taste. So, please use the sake meter value only as a rough reference.

Rika: Do you have any special sake?



Owner: Yes, there is a sake called *kijo-shu*. Normal sake is made using 130 L of water for 100 kg of rice. *Kijo-shu* is made using 70 L of water and 60 L of sake for 100 kg of rice. You can call it sake made with sake. It has a rich taste with balanced sweetness and acidity. After aging, its color will change to amber. Besides that, there is long aged sake and cloudy sake as a variation of sake. Recently, sparkling sake is produced. It is good for toasts and popular among women and the younger generation.

Rika: Wow, I've learned so much about sake.

Owner: OK, now you can choose the sake that you really want.



## How to evaluate and enjoy sake

The opinions of specialists may be useful, but the most important thing is to find sake that you like. In other words, just as everyone has his/her own favorite foods, taste for sake depends on the person. How do we evaluate sake and how is it served?

### (1) How to evaluate sake

Like other alcoholic beverages, sake is evaluated on the basis of color, taste, and aroma. A ceramic cup with two blue concentric circles on the bottom, called *kikichoko* is used for sake tasting by professionals.

#### Color:

The color and transparency are evaluated. Sake with dark yellow or brown color has probably been stored for a long time. Blue circles on a *kikichoko* (tasting cup) are useful to see the color and transparency of sakes.



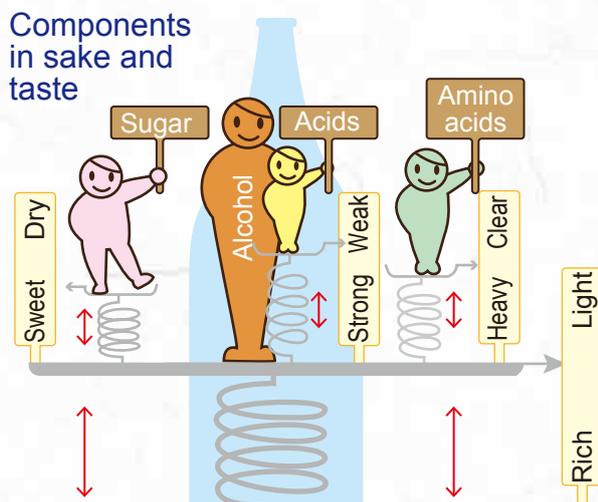
*Kikichoko* (tasting cup)

#### Aroma:

There are many kinds of aroma in sake, including a fruity aroma called *ginjo*-aroma, the rich aroma of aged sake. They are evaluated on the basis of strength and balance.

#### Taste:

Taste is evaluated on the scales of: sweet/dry, rich/light, and with/without umami. If a sake contains a lot of sugar, it tastes sweet. If there is less sugar in it, it tastes dry. On the other hand, the acidity of sake offsets the sweetness of the sugar. Even if the sugar level is the same, the more acidic sake will taste dryer, and the less acidic one will taste sweeter. Concerning richness and lightness, a sake containing a lot of alcohol, sugar, acid, or amino acids will taste rich, and a sake with less of these components will taste light. A sake with a high level of amino acids may suffer unpleasant heavy taste after it has aged.



### (2) Temperatures for serving sake

You can enjoy sake at various temperatures and with various dishes. Unlike beer and wine, sake can be enjoyed at a wide range of temperatures. The appropriate temperature for serving depends on type of sake.

*Ginjo-shu* has the aroma of apples or bananas, so it is suitable to drink cool. Sake with a fruity aroma is good for the first half of dinner. Most *junmai-shu* have a rich taste, so they are suitable for serving with rich-tasting dishes cooked with soy sauce, sugar and oils. They can be served at various temperatures, from cold to hot. Strong matured flavor and acidity will be softened by warming, which makes it even more delicious. *Honjozo-shu* is a versatile sake that can be enjoyed from cold to hot. *Honjozo-shu* will go well with any dishes.



### (3) Combinations of sake and dishes

Each region of Japan has its own unique local dishes. People feel that a local dish goes well with sake made in the same region. Please try local sakes in various regions.

### (4) Drinking cups

The taste and aroma of sake differ depending on drinking cup.

There are many sake cups made of different materials (ceramic or glass) and shape (widely opened or narrow and tall). Recently, an increasing number of restaurants are serving sake in wine glasses. With different types of sake cups, how does sake taste? Let's try and enjoy!



*Choko* (sake cups)



*Tokkuri* and *choko*



**National Research  
Institute of Brewing**

3-7-1, Kagamiyama, Higashihiroshima,  
Hiroshima, 739-0046  
TEL : +81-82-420-0800 FAX : +81-82-420-0802  
e-mail : eng\_info@nrib.go.jp

**Website:  
[https://www.  
nrib.go.jp/  
English/](https://www.nrib.go.jp/English/)**

If you have any questions regarding this booklet, please direct your inquiry to our Information and Technology Support Division.

August 2022