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SOY What?

NET 150 ml 5fl.oz

Soy What?

Beginner's Guide to Soy Sauce Homebrewing

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Preface

Soy what now? That's right, soy sauce! This book is a specially curated, easy, yet informative step-by-step guide to brewing your own soy sauce.

Soy sauce is more than just sushi's best friend. It's a whole other culture. So, get a hold of your chopsticks and let us embark on an exotic and exciting adventure that allows us to understand the history and experience the wonderful flavours of soy sauce.



Chapter 1

Soy Sauce – Once Upon A Time

Soy sauce is a traditional fermented condiment, popularly known for its salty and intense umami taste, as well as inseparable pairing with sushi and other Asian dishes. The origin of soy sauce dates back to the early 3rd century in China when *Jiang*, a savoury paste derived from fermenting meat or fish, was made. However, with the expansion of Buddhism from India into China during the Han dynasty around 220 BCE, the values of non-violence and vegetarianism were upheld high, so the raw materials were replaced by beans or grains such as soybeans or wheat. Another reason is that it was easier to harvest them.



Later on, in the 7th century, Japanese Buddhist priests who were studying in China returned home and discovered a new method to make a dipping sauce from the liquid of fermented miso-like soybean paste. This method was spread to Japan and became the base of *shoyu* or Japanese soy sauce.



The English term "soy sauce" has originated from the Japanese word *shoyu* via the Dutch. This was because the Dutch were the only Europeans who were allowed to trade with Japan in the 1600s after Japan expelled the Portuguese. The Dutch East India Company (VOC) exported from Japan approximately 46,000 litres of soy sauce, which they transported via Batavia (today's Jakarta, Indonesia) to Amsterdam, the Netherlands.

It was from there that soy sauce had been traded to merchants from around the world. This dark brown liquor-like condiment subsequently began to spread to other South Asian countries and evolved worldwide! Currently, the production takes place in Vietnam, Taiwan, Japan, Thailand, Korea, the Philippines, Indonesia, and Malaysia, among other countries.



From Meh to Yum! – Fermentation Process

Before we get into the details, you might be asking. What exactly is fermentation? Well, my friend, let's just say that fermentation is like a makeover. It transforms something ordinary into something special, like from a normal grape into a fancy wine. But, if we were to put it in a scientific term, fermentation is a chemical process where microorganisms, such as bacteria, yeast, or mould break down big sugar molecules like glucose into simpler molecules without the presence of oxygen. Fermented foods and beverages such as bread, wine, sourdough, and soy sauce have different ingredients and microorganisms working inside, which makes the fermentation process varies and their end-product distinct and unique.

But, why do we ferment our foods? Fermentation is done for several reasons, including preserving the food or making food safer to eat. The fermented meat or fish in the making of the Chinese Jiang discussed earlier had been done to preserve them as they are perishable. However, it is most often that fermentation has been done for the sole purpose of flavour. Who doesn't like eating well?

Alright, time to get back to soy sauce.

Despite various versions of soy sauce around the world, they undergo the same two-step fermentation process called koji fermentation and moromi Koji fermentation. fermentation adding begins by koji mould Aspergillus oryzae into a mixture of cooked soybeans and wheat flour. This mixture is then left to ferment for 3 days at 25-35C, which results in koji with yellow-greenish colour.





Moromi fermentation is where the matured *koji* is mixed with brine solution normally containing 18-22% of salt and left to ferment, ranging from 3 months up to 4 years.

"Hold up, hold up... 18-22%? That is an insane amount of salt! No wonder it's so salty", you might think.

Well yes, it is. This high amount of salt is actually essential during moromi fermentation. It prevents the growth of unwanted microorganisms and improves the flavour profile and texture of the final product. That is why soy sauce is sometimes used as a substitute for salt in cooking a dish.



Let's Travel! - Types of Soy Sauce Around the World

As we discussed in the previous chapter, soy sauce travels from one country to another, and each country has different variations, mostly based on the composition of the raw material. Let us show you the popular ones.



Chinese soy sauces use soybeans with a small amount or no amount of wheat, where the soybean to wheat ratios can be 80:20 or 70:30. Based on the fermentation procedure, Chinese soy sauce can be divided into two types, namely high-salt liquid state fermentation soy sauce (HLFSS) or known as the traditional Chinese dark soy sauce and low-salt state fermentation soy sauce (LSFSS) or known as Chinese light soy sauce. HLFSS has a more intense flavour and appearance and is mainly used for the slow-cooking dish. While LSFSS has a shorter fermentation time and light flavour and colour. Chinese-type soy sauce is the base method in regions like China, Indonesia, Malaysia, Philippines, Singapore, and Thailand.

Japanese soy sauce (shoyu) can be categorized into five types, namely koikuchi shoyu, usukuchi shoyu, saishikomi shoyu, tamari shoyu, and shiro shoyu. Koikuchi, usukuchi, and saishikomi shoyu consist of an equal amount of soybeans and wheat, however, they differ in the fermentation process. Koikuchi shoyu (Japanese dark soy sauce), the commonly consumed soy sauce in Japan, usually undergoes a lengthy brine (a mixture of salt and water) fermentation process, which results in an intense aroma and a deep-reddish brown colour. Usukuchi shoyu (Japanese light soy sauce) is made with a shorter brine fermentation process, which results in a lighter, redbrownish colour and milder aroma. For saishikomi shoyu, instead of using a brine solution, the second fermentation step is done with raw soy sauce (double-fermented soy sauce), which then results in a full aroma and bodied taste as the end product. On the other hand, a high ratio of wheat to soybeans is used to make Shiro shoyu (white soy sauce), which has a much lighter yellow to tan colour due to fermentation conditions. While shiro shoyu uses 90% of wheat, the use of a large amount of soybeans and 10% or less wheat is done to produce tamari shoyu (tamari soy sauce). Despite the lack of aroma, tamari shoyu has a higher viscosity and darker colour than koikuchi shoyu.

In Korea, most fermented Korean condiments are made using *meju* as a starting material, including *doenjang* (soy paste) and *ganjang* (soy sauce). In order to prepare *meju*, soybeans are soaked, steamed and moulded and aged for 1-2 months. *Meju* has a characteristic taste that is caused by various species of moulds (*Aspergillus, Penicillium* and *Mucor*) on the surface of the balls. *Meju* can be further fermented into soy sauce, *ganjang*. Traditionally, the *meju* is tied with rice straws and hung to dry for 40 days. After the *meju* has been dried, it is stored at a warm temperature to enable fermentation. Salt water is then added to the fermented *meju*. When the salt water turns brown, it is now called *ganjang*.

Taiwanese soy sauce (*inyu*) tends to have a much higher salt content than the Japanese types mentioned previously. Instead of yellow soybeans and wheat used in the latter, *inyu* is derived from black soybeans and rice bran.

Indonesian soy sauce (*kecap*) can be divided into two types, *kecap asin* (salty soy sauce) and kecap manis (sweet soy sauce). Sweet soy sauce has added caramelized sugar and spices, which makes the final product thick and sweet.

Regardless of the types of soy sauce available, there are three basic ingredients used in every soy sauce production, which are soybeans, wheat, and brine solution. Moreover, although different types of soy sauce have different proportions of starting materials, the umami flavour is common for all.



Shh! It's The Secret Army – Microorganisms

Is it just us or have you also ever wondered how it forms that complex and sophisticated aroma and flavour? The answer lies within soy sauce's little army.

Microscopic yet powerful, these armies are in charge of the formation of the aroma and flavour of soy sauce. Notable microorganisms that are present during soy sauce productions are a variety of lactic acid bacteria and fungi. Let us first familiarise ourselves with these microorganisms.



Lactic acid bacteria (LAB) are a group of bacteria that have the ability to convert sugars and produce organic acids, such as lactic acid, as their end product during fermentation. LAB are found in various fermented foods and come from the genera of Lactobacillus, Pediococcus, Enterococcus, Lactococcus, Leuconostoc, Oenococcus, Streptococcus, Tetragenococcus, Carnobacterium, Vagococcus, Weissella, and Alkalibacterium. LAB has a significant role in developing flavour and texture during the fermentation and the final

product.

There are two types of fungi, yeast and mould. So, what is the difference between these two? Yeasts are single-celled fungi that are capable of converting sugars into alcohol as their end product. While moulds are filamentous fungi that have the ability to produce enzymes and use them to break starches into sugars and proteins into amino acids.

Soy sauces from around the world differ in terms of the number of microorganisms involved in the fermentation process, starting materials, handling process, fermentation conditions and how long it takes to make them. Not only that, the microorganisms during each step of soy sauce production tend to change. For example, the variety of microorganisms during *koji* fermentation is higher than in *moromi* because of the high salt content present in moromi. Also, the longer the *moromi* fermentation time, the lesser the number of microbial communities, especially in the mid to late stage of moromi.

However, there are two secret weapons aka essential microorganisms that make a major contribution to the flavour and aroma of soy sauce, namely *Tetragenococcus halophilus*, an LAB, and *Zygosaccharomyces rouxii*, a yeast. Both microorganisms have been found abundantly in moromi. Although these microorganisms can be found naturally in moromi, nowadays they are added as a mixed starter culture in moromi to enhance the sensory properties of soy sauce.



T. halophilus is a lactic acid bacteria that is capable of living in a high salt condition (halotolerant). T. halophilus plays an important role in soy sauce production as it is known to produce around 26 compounds and some of them are aromatic compounds, which produce the aroma of soy sauce. Interestingly, this bacteria is also capable of producing glutamic acid, which is the source of umami taste.



Z. rouxii on the other hand is a yeast that is mostly known to be the cause of food spoilage. However, in soy sauce fermentation, it contributes to improving the flavour of soy sauce, since it has the ability to increase the concentration of aromatic compounds.

Mmmhh That Tastes Good! – Flavour of Soy Sauce

When we say flavour, it's not only one thing. A combination of taste and aroma is what is described as flavour. Much like its history, soy sauce has a very rich and complex flavour. Let's start with the taste.

Soy sauce has all the 5 basic tastes, including sweet, salty, sour, bitter (yes, even bitter, we were surprised as well), and umami. Not only that, two additional tastes are detected in soy sauce, kokumi and astringent.

Did you know?

Despite having the five basic tastes as flavour identifications, some foods have flavours that are unable to be classified to those identifications, like mouthfeel, continuity, and thickness. *Kokumi* comes from the Japanese terms, *koku* (rich) and *mi* (taste). Although *kokumi* do not have a specific kokumi taste, it can amplify the mouthfeel, continuity, and thickness of sweet, salty, and umami tastes. Amazing, right?

But, that's only for the taste. For the aroma, oh boy, it's much more complicated. Like perfume, soy sauce has various aromas and each aroma is associated with particular chemical compounds found in soy sauce. For example, one of the odour-active compounds called furfuryl alcohol is the cause of sugar-burnt aroma, or if you have ever smelled soy sauce and noticed that smoky/bacon aroma? That is because of a compound called 4-ethylguaiacol. Here are the taste and aromas detected in soy sauce.

Taste





Salty











Sweet

Sour

Bitter

Umami

Kokumi

Astringent





Caramel, Sweet



Malty, Almond



Spice, Fenugreek



Cooked potato



Fruity, Sweet



Floral



S



Sulfur, Cooked Vegetables



Nutty, Grassy



Meaty



Smoky, Burnt



Cheese, Soup



Spicy



Honey, Sweet



Mushroom



Here is the list of compounds attributed to each taste and aroma.

Taste		
Sweet	Serine, proline, glycine, glucose	
Salty	NaCl	
Sour	Organic acids, acidic peptides	
Bitter	Valine, methionine, isoleucine	
Umami	Aspartic acid, glutamic acid	
Kokumi	Kokumi peptides	
Astringent	Peptides, phenolic compounds	

Aroma		
Caramel, sweet	4-Hydroxy-2,5-dimethyl-3(2H)- furanone (HDMF)	
Spice, fenugreek	Sotolone	
Cooked potato	Methional	
Fruity, sweet	Ethyl 2-methyl-propanoate	
Floral	2-phenylethanol	
Malty, almond	2-and-3-methyl-butanal	
Sulfur, cooked vegetables	Dimethyl trisulfide	



Source: Diez-Simon et al., 2020

Is Soy Sauce Worth the Wait? - Yes!

It is known to many that soy sauce takes quite some time to make. However, when you have finally perfected this craft, you will be reaping multiple health benefits. Thus, it is not just a rich seasoning, it is also a functional food. It does not sound surprising that in Japan alone, each person consumes 30 ml of soy sauce each day according to the Japan Soy Sauce Brewers Association. Firstly, soy sauce promotes digestion by enhancing your stomach gastric juice secretion. It also possesses anticarcinogenic compounds. Soy sauce also protects your gut against bad bacteria such as *Salmonella enteritidis*, which can cause diarrhoea and fever. Last but not least, its antiplatelet characteristics give this wondrous dark-brown liquorlike condiment the ability to prevent blood clotting.

Chapter 2

Wait A Minute! - Rule of Thumb

Before we get on to the fun stuff, we have to pay attention to the rule of thumb. As said in the previous chapter, fermentation is like a makeover, it transforms one product into another. However, every step is crucial and it determines the final product. Any sign of spoilage would ruin the whole fermentation process and it will become tedious as the fermentation process costs us a lot of time and also resources. So, the rule of thumb is...

Hygiene! Before every step in the fermentation process, any equipment that is going to be used needs to be cleaned and dried first. This is optional, but you can also use 70% ethanol spray to disinfect all equipment before you use it. Make sure to remove any dirt, food or water excess. This would avoid any spoilage or contamination.

Preppin' It - The Materials and Equipment You Need

As this is a guide to making a homemade soy sauce, the materials and equipment used here are designed to produce moromi on a 3 L scale.

Raw Materials

Koji starter culture

Koji starter culture consists of dried A. *oryzae* spores and normally it's in the form of powder. If you are in Japan, then great! You can buy it in a local store. But if you are outside of Japan, then you might check in Asian stores or if any, special stores that usually sell raw materials to make fermented products. If you still are unable to find it, as always you can shop online.

Salt

The salt concentration used in the brine solution is 18%.

Soybeans You can buy your yellow soybeans from the local market.

Water Use mineral water.

Wheat

If you use wheat grains, you need to roast and ground the wheat grains as smooth as possible, prior to use. Alternatively, you can buy ready-made wheat flour in your local store.

Koji Recipe Soybeans: (dry weight) 0.385 kg, (wet weight) 0.770 kg Wheat flour: 0.28 kg *Koji* starter culture: see instructions in the packaging

Brine Solution (20%)

Salt: 400 gr Water: 2 Liter

<u>Equipment</u>

Bottle

You can use any type of bottle as it is only used as a vessel for the final product.

Cheesecloth Use to cover the koji trays. You can also use tissues.

Cooking pot Use to boil the soybeans and moromi.

Large glass jar

Use during moromi fermentation. Because we are going to make 3 litres of soy sauce, the volume of the glass jar should be at least 5 litres.

Ladle

Use to stir when boiling soybeans and moromi.

Sieve

Use to strain the soybeans and moromi. To strain the soybeans, you can use a big-holed sieve for easier straining. For moromi, we suggest using a fine mesh strainer to separate the liquid.

Thermometer

Use to check the temperature.

Trays

Use for koji fermentation. If possible, use wooden trays, but if you don't have them, then any normal trays would do.

Weighing scale Use to weigh the raw materials.

Alright Then, Let's Do It! – Making Soy Sauce

Preparing the Soybeans

Step 1 - Wash the soybean and make sure to remove dirt or any physical contaminant. Drain the dirty water. Fill it with new water again about 3 times the volume of soybeans and soak for 24 hours. The soybeans will absorb the water and swell to twice their size.

Step 2 – After 12-16 hours, usually you will see some foam forming and the skins floating on the top. Drain the water and wash the soybeans once more. You can de-hull the soybeans or not, it's your choice.

Step 3 – Transfer the washed soybeans onto the cooking pot. Fill it with water 3 times the volume of soybeans and boil it over high heat. After the bubbles are forming, bring the heat to medium-low and simmer for one hour until the soybeans are softened.

Step 4 – Drain the cooked soybeans with a sieve and spread it to allow the soybeans to cool down to room temperature.

Another option – You can also use a pressure cooker if you have it. Fill it with water and steam cook the soybeans for about 90 minutes.

Preparing Moromi

Step 1 – To make a 20% brine solution, dissolve 400 grams of salt in 2 litres of mineral water.

Step 2 - Transfer koji and brine solution into the glass jar. The ratio of koji:brine is 1:3. For 2 litres of brine, add 1.05 kg of koji. Stir the mixture (moromi) and cover it with a tight lid.

Step 3 – Ferment moromi at around 30C for 3 months (or more if you want). During the first week, stir the mixture every day. After that, mixing can be done weekly.

Filtration and Pasteurization

Step 1 - Pour moromi into cheesecloth and squeeze it to obtain the liquid.

Step 2 – Transfer the liquid into a cooking pot and pasteurize the liquid by medium heat until it reaches 75C (check it with the thermometer). Once it has reached, hold the temperature between 75-80C for 15 minutes and stir occasionally.

Step 3 – Turn off the stove and let the pasteurized liquid cool down to room temperature. After that, transfer the liquid into a bottle and your soy sauce is ready to be consumed!

Chapter 3

Spill the Sauce, Sis! - Tips

Tip 1 - After you drain the cooked soybeans, use a tissue or cloth and dab it to remove the excess moisture while you air dry it.

Tip 2 - If you want a darker soy sauce colour, ferment the brine under the sun! But be careful of any physical contaminant from the environment.

Tip 3 - The longer you ferment your moromi, the richer the flavour you are going to get. You can ferment up to a year or even two.

Tip 4 - After squeezing the liquid out of the moromi mash at the end of the fermentation, you can use the paste in your dish by adding the paste with water and boiling that to make a miso soup or add the paste to a stir fry. Talk about that umami boost!

Don't Worry, I Gottchu Fam! -Troubleshoot

Why is my koji black and foul-smelling?

This means that your koji is spoiled, please discard and make a new one. This can be caused by multiple factors:

- The soybean-wheat mixture is still too wet as the soybeans were not dried properly

- There may be excess water at the bottom of the mixture

- The mixture may be too thick, not allowing fungi to grow at the bottom of the koji

- The koji starter culture was added when the mixture was still warm, so the fungi died

- The koji may be fermented at an unsterile place, so flies or other pests can contaminate it

Why is my koji sticky or natto-like?

This might be because you add the koji starter culture before letting the soybeans cool down after you cook it. Instead of our fungi that grows, a bacterium named *Bacillus subtilis* takes over causing bacteria to grow faster than fungi, especially on increased temperature. If you want to make natto (fermented soybeans), this is probably correct as *Bacillus subtilis* is the starter culture to make natto, but you should still discard this and make a new one.

Is it normal if my koji is getting hotter?

Yes, that is normal as during the fermentation process the koji produces heat.

Why is there mould forming on top of my moromi?

This is possible because you may not have stirred it often so there is mould growing on top. If the moromi smells normal, then you can just throw away the mould and continue with the fermentation, but do not forget to stir it often. However, if the mould is black, the smell is unpleasant and the colour of moromi might be different, then unfortunately it is definitely spoiled and you have to discard it.

There is a filmy layer on top of my moromi, can I just mix it with the rest?

In this case, this is yeast growing and forming a sticky or filmy layer. Similar to before, if you notice that the smell is normal, just throw away the top layer and stir the moromi.

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