

Begin with Rice & Water

A Primer on Brewing *Makgeolli*



Makgeolli



Why this pamphlet?

This pamphlet exists to introduce home brewers to the principles of making makgeolli, a raw, unfiltered rice alcohol at least as old as the nation of Korea itself. We will cover the historical and cultural context briefly, and introduce a basic recipe which forms the starting point of hundreds of others. This recipe can be carried out in even a minimally appointed kitchen using household implements with a minimum of specialized tools and ingredients. Most ingredients as well are available in most parts of the world, and cheaply so, especially compared to the marked up retail cost of a comparable - but frequently inferior - finished retail product, as is typical of home fermentation.

Makgeolli will challenge the beer and wine brewer, in that it asks that its maker make peace with a certain kind of controlled chaos: if beer and wine require the precise timing and control reminiscent of baking, makgeolli is a bit more of the rule-of-thumb, steering-general-principles-according-to-taste of stovetop cooking, rewarding those who learn its basic principles and apply their own creativity with an eye to the flexibility and inherent fickleness of Korean brewing. We have found ourselves richly rewarded over the years as our knowledge has expanded, and discover novelty in even the most basic recipes the more we repeat them. One of our favorites, and a common foundation stage for more complex, longer-term recipes, we present here for the enjoyment of all.

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Begin with Rice & Water
A Primer on Brewing *Makgeolli*

I. What is makgeolli?

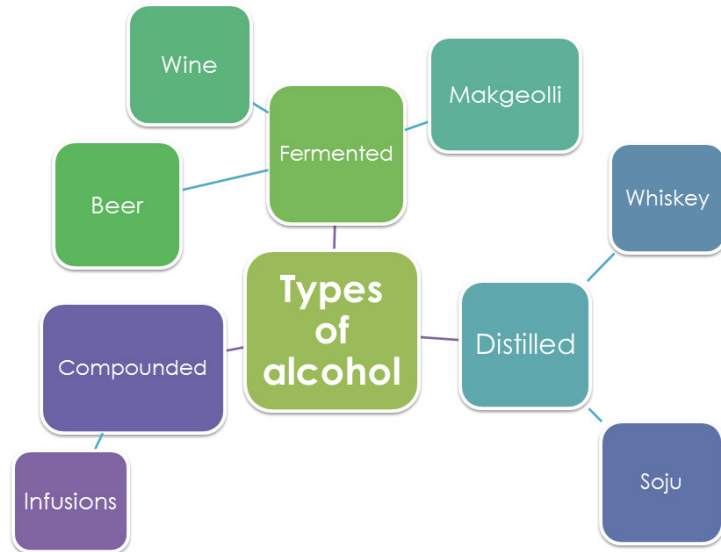


I. What is makgeolli?

A. Global Context

Without going into comprehensive depth, a few important distinctions are important to bear in mind when dealing with makgeolli. Most contemporary, commercial examples of makgeolli readily available are not representative of the traditional form, and indeed are well along a path of a modern fusion appealing most to production cost, shelf life and distribution, and consistency of flavor.

Makgeolli is a fermented, alcoholic beverage traditionally made from rice, and traditionally consisting of only three ingredients: grain, *Nuruk*, and water. It is unfiltered and ideally served unpasteurized, and is characterized by a sedimentary layer, from which it gets its technical designation, which is *Takju*. While often pasteurized for shipping purposes, doing so dramatically weakens the flavor derived from the live fermentation of a typically wheat-based complex called nuruk, which is essentially a coarse wheat cake colonized by a variety of molds, from which enzymes are produced, yeasts, and bacteria. Various strains of bacteria saccharify simpler starches broken down by enzymes and by heat during the cooking process, the yeast finally producing alcohol from the resulting sugars.



Makgeolli is particularly distinct from wine or beer in that it is a multiple parallel fermentation, with saccharification and transformation of sugars to alcohol happening simultaneously and throughout the fermentation, continuing even after bottling. Wine, being from macerated fruit, has simple sugars freely available to the yeast and is fermented in a single stage with the exception of kosher wine, which undergoes a boiling process before fermentation. Beer has two distinct stages, where the grain is cooked to make wort and cooled before adding yeast. While this more closely resembles the makgeolli process, transformation of the grain in beer to a fully liquid wort means that before yeast is added, all of the available starch has already been transformed to sugars. In brewing makgeolli this transformation is ongoing, and inhibits the measuring of potential alcohol since in the mixture is whole rice as well as a great deal of untransformed starch.

I. What is makgeolli?

Makgeolli is often called rice wine or rice beer, and is usually defined as it compares to better known alcohols. However, this comparison invites a loss of understanding how and why makgeolli differs, and unfortunately, those distinctions are often drawn in cultural or nationalistic lines which focus on aspects of culture and consumption rather than the drink itself. This confusion creates the kind of atmosphere where ‘makgeolli’, which literally means ‘a roughly filtered thing,’ is attempted to be translated rather than learned as a unique term, and leads to some embarrassingly short-sighted attempts at cultural marketing.

While such attempts have in the past included a contest to officially rename makgeolli, with ‘drunken rice’ taking first place¹⁾, there is a great similarity to beer as a drinking experience, diluted takju being carbonated and light on the tongue as many beers are, and in some ways comparable to medium bodied ales. *Cheongju* can be dry and tart, able to resemble an aged, oaked Chardonnay in many respects, or steered into territory as sweet as ice wine. Just as one who enjoys kimchi simply calls it that, and describes it as fermented cabbage, call makgeolli just that, ‘makgeolli’, as calling it ‘wine’, or even ‘rice wine’ and ‘rice beer’, doesn’t contribute to understanding it, and doesn’t help to establish it in the minds of those who are new to it.

The complexity of the nuruk culture is a particularly notable departure from most other fermentation styles and in principle most closely resembles the Lambic process. It contributes enormously, even principally, to the flavor profile and mouthfeel and each variety of nuruk is characteristic of the locale in which it is produced.

1)
Makgeolli: The rice wine
revolution is here. CNN,
30 May 2011.



Comparable styles of this starting culture exist elsewhere in Asia, with Thai *Sato* being another example of a typically unfiltered raw rice alcohol produced by a similar complex, though typically rice-based, called *Paeng lao*. Japanese *Sake*, however, is made using a single organism, *Aspergillus oryzae*, cultivated on cooked rice, called *Koji*, which must be complemented with a separate portion of yeast to facilitate the transformation of sugars to alcohol, as the *Aspergillus oryzae* only transforms more complex rice starches into sugar.

Koji, being better known to the English speaking world and called *Ipguk* in Korea, has unfortunately become a stand in for nuruk in the Western culinary world although they have little in common besides being host to a type of mold, *Aspergillus oryzae*, grown on a type of grain, rice when concerning sake, but either rice or wheat when concerning nuruk. While nuruk also contains *Aspergillus oryzae*, it is the complexity and the simultaneity of the fermentation that makes it stand out. It is worth noting that many commercial brands of makgeolli do use ipguk because of its comparative simplicity, but that this is a rather dramatic departure from the traditional character of Korean takju, and the resulting brew lacks the depth of alcohol produced with nuruk. Sake and sato both also use the multiple-parallel fermentation process characteristic of *Jeontongju*, or traditional Korean alcohol, with sato actually most closely resembling makgeolli, as sake is typically filtered, pasteurized, and matured before serving, though exceptions do exist.

Additionally, sake rice is commonly polished to a mere 30-40% of its original size to limit the amount of protein and lipids in the

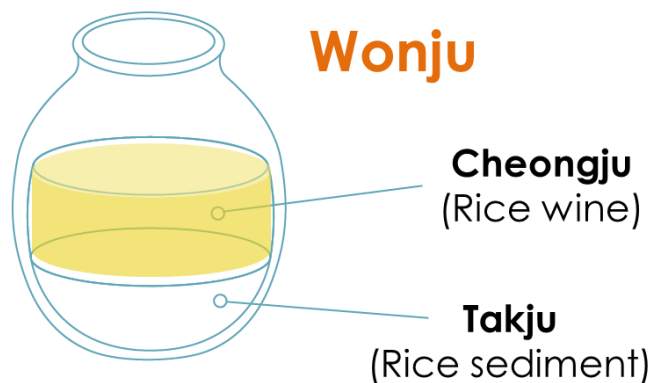
I. What is makgeolli?

fermentation in order to create the characteristic floral bouquet and flavor of sake, which exists within a well-defined ideal. Makgeolli is made using rice which has more than 80% of its original grain, and the results have a richer, and sometimes more chaotic flavor profile which achieves what the brewer defines as ideal, strongly characterized by the presence of fruity esters.



Most contemporary makgeolli is sweet and only 6-8% ABV(alcohol degree), being diluted after filtering, and the vast majority of market products are sweetened artificially with aspartame or saccharin, the former being introduced in the early 1980s after saccharin was outlawed in Korea. Few notable exceptions exist, but those brewers who do refine a recipe to such a result that it does not necessitate the addition of a very much non-traditional sweetener belong to a diminishing but elite cohort which preserves and evolves

What classification of alcohol we making?

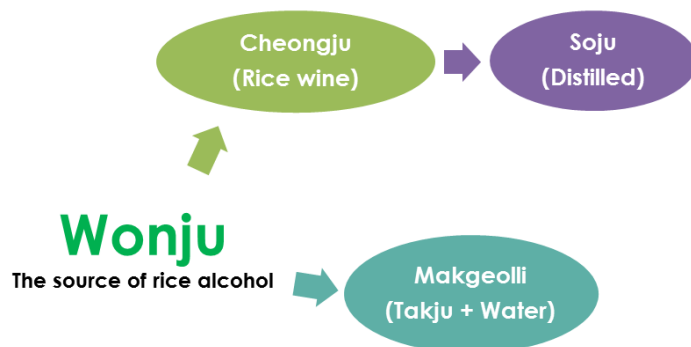




traditional Korean brewing without sacrificing the aspects of that brewing process which distinguish it from its neighbors.

Makgeolli has historically also been a drink to divide social classes, with diluted takju - again, commonly recognized as ‘makgeolli’ - being made by and served to farmers, and the clearer, stronger cheongju, which keeps longer and matures in a way that takju typically does not, being served to the *Yangban*, or aristocracy.

While makgeolli is derived from the brewing process taught in this book, the direct result of recipes such as those contained in this work is more accurately called *Wonju*, which consists of two distinct layers that can be seen when the strained alcohol settles: a top, transparent and often yellow layer called cheongju, which can be served separately or distilled to make *Soju*, and a lower sedimentary layer called takju, which is typically diluted to a weaker strength according to the taste of the brewer. While ‘makgeolli’ is sometimes used as a casual catch all phrase for any sediment-containing Korean alcohol, again, it more specifically refers to diluted takju. Additionally, when



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wonju or makgeolli is referred to as being 'filtered', it is generally meant in a very basic way, rather than through a very fine or charcoal filter as sake is, hence the richer color and indeed the resulting characteristic sediment.

The character of the base fermentation from which the soju is distilled will affect the flavor of the resulting spirit, as will the length and condition of storage afterwards. Soju, like any distilled spirit, responds well to cold condition and maturing, though few contemporary distillers pursue this end, instead diluting the spirit to a paltry 17-21% ABV and sweetening it, hence producing the oft-envied retail unit sales volume not known to producers of more potent liquors.²⁾ This particular dilution is especially odd when noting that numerous Korean yeast strains can achieve up to 23% ABV through multiple-stage fermentation, and its sister alcohol, sake, is commonly as strong as 19% ABV without necessitating distillation.

2)
soju: The most popular
booze in the world. The
Guardian, 2 December
2013.



B. Historical Context

Alcohol has been around since the dawn of civilization. Along with other basic types of fermentation, purposefully fermented alcohols are old enough as to be prehistoric in numerous sites worldwide, with the oldest dated examples being fruit wines. In Korea, fermented alcohol dates back at least to similar prehistoric folk stories transmitted from China. Just as in other grain-based brewing methods such as beer, *Sul* the term for the family of Korean alcohols, relies on saccharification of rice, barley, and other cereals and starches found on the Korean peninsula and surrounding regions.

According to a Chinese historical document, spittle consisting of chewed rice was used to produce alcohol called *Miinju* [미인주, 美人酒, rice-wine made from chewed rice]³⁾. Because human saliva contains an enzyme called ptyalin, it can break down starch from rice and convert to sugar. When these converted sugars interact with wild yeast, alcohol is made. Fermented alcohols may plausibly predate organized agriculture, but more likely co-evolved with cultivated cereals, particularly those which require large amounts of water to grow, or which require leaching to reduce endotoxins, as exposure to water and airborne yeasts naturally result in fermentation over relatively brief periods of time.

Although the exact time of the introduction of the very first alcohol in Korea is unknown, it was probably made in a similar way of making *miinju*, which matches basic methods of producing alcohol as far away as South America, where a mouth-chewed corn alcohol

3)
『식품과학기술대사전』,
한국식품과학회,
2008.4.10.
광일문화사

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is called *Muko*. The oldest Korean historical documents that mention sul are those that record the mythology surrounding *Jumong*⁴. These stories focus on the circumstances surrounding the birth and life of jumong, a founder of the *Goguryeo* kingdom.

Some Japanese historical records describe a *Susubori*, meaning a brewer, introducing brewing science to Japan. Interestingly, the record mentions that one such susubori used nuruk to make alcohol, suggesting a lengthy tradition of using what is still the basis of traditional brewing on the Korean peninsula, and perhaps a tangible common ancestor linking makgeolli and sake⁵.

Brewing science improved rapidly during the *Goryeo* dynasty corresponding with a heightened period of cultural exchange with kingdoms in the southern region of what is now China. In this period, a department called *Yangonseo*⁶ (literally translated, 'virtuous brewing department') was established, managing the use of rice to brew alcohol for the royal court. Towards the end of the dynasty, invading forces from Mongolia also brought a distillation method, thereafter establishing soju⁷ as a popular alcohol.

In the *Joseon* dynasty, as brewing science improved, brewers came to exploit multiple brewing methods, which resulted in a greater variety and sophistication of both fermented alcohols and distilled liquors. As Confucian culture developed, the necessity for families to brew alcohol at home became common as a necessary component of memorial rites for ancestors. This extreme localization helped to foster regional diversity in both brewing methods and recipes, as well as making it difficult to establish a cohesive set of aesthetic criteria to

4)
『동명왕편[東明王篇]』,
동국이상국집
(東國李相國集),
이규보, 1241 AD

5)
『고지키 [古事記]』,
오노 아스마로, 712 AD

6)
『고려사(高麗史)』,
1451 AD

7)
『식품과학기술대사전』,
한국식품과학회,
2008.4.10. 광일문화사.



assess and compare different varieties of alcohol.

While home made liquors were typically not taxed the occupation of the Korean Peninsula by the Empire of Japan at the end of the Joseon dynasty resulted in a government-enforced Liquor Tax Act in February of 1909⁸. Afterwards, alcohol was only allowed to be produced in licensed breweries, and home brewing was prohibited. This precipitated the decline of regional alcohols, in terms of cultural knowledge as well as active brewing practices that existed outside of commercial standards.

As Korea endured chronic famines due to Korean War, agricultural shortages, and grain rationing, the Grain Management Act of 1964 essentially put an end to rice-based brewing. As makgeolli came to be brewed with unregulated and inexpensive grains such as wheat and corn, it began to lose ground to soju in the market as changes to generations-old recipes shook the faith many had long held in its once-lauded quality and familiar character⁹. However, as the development of hybridized rice came to replace conventional crops, a return to rice-based makgeolli became possible. By this point, though, tastes had changed, having found favor with both domestic beers and imported whiskies, in addition to sweetened and progressively weakened types of soju, hence laying the grounds for spiking makgeolli with a recently introduced sweetener that would not be consumed by the live nuruk culture: saccharin. Such would remain the case for almost a decade, when saccharin was outlawed for use in food products and aspartame became its universal replacement.

As such, the basis for what many know as makgeolli today was

8)
『한국세정사』
장병순, 보성사, 1973

9)
『의심 많은 교양인을
위한 상식의 반전 101』,
김규희, 황선정, 송진욱,
2012.9.24.

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set from an insecure position aimed at competing for sales, rather than reviving a tradition that was essentially smothered when the nation of Korea could not afford to use rice for anything but subsistence, and only in recent years has a return to that tradition been of interest to anyone outside a small circle of dedicated brewers who have spent entire lifetimes keeping a very dim flame alight.

II. Ingredients



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Makgeolli is made of a minimum of three ingredients: grain (usually rice), water, and fermentation starter (nuruk), and can often contain additional yeast and/ or flavoring ingredients such as herbs and fruit.

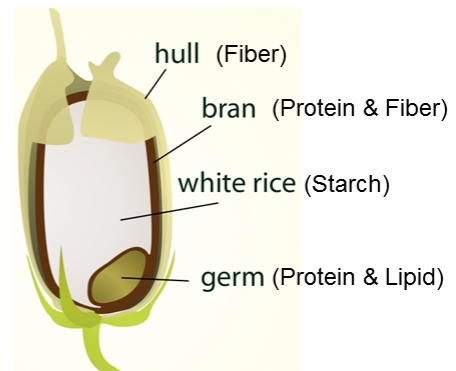


A. RICE

Let's take a closer look at one of the most important ingredients in makgeolli: rice. Like other cereal grains, rice is composed of four layers: the hull (fiber), the aleurone layer (protein and fiber), the endosperm (starch), and the germ (protein and lipids). The fibrous hull is removed and most of the protein-rich bran and germ are polished off in commercial white rice.



Rice grain structure



- Rice seed
- Rice grain with hull
- Brown rice
- Rice grain without hull
- White rice
- Rice without hull, bran and germ

In the Japanese sake brewing tradition the rice is polished to a mere 30-40% of its original size in order to reduce the grain to a pure starchy core of the glucose molecules amylose or amylopectin. However, in Korean brewing, the rice grain is left relatively whole, leaving a protein outer layer in addition to the starchy inner core. In fact, unlike the rice used for sake, the quality of rice for eating and brewing in Korea is the same. This difference in degrees of polishing and thus protein content between rice destined for sake and that destined for makgeolli has a profound effect on the final flavor of the brew.



II. Ingredients

There are two kinds of rice typically used in Korean traditional alcohol: *Mepssal* (멥쌀) and *Chapssal* (찹쌀). Mepssal, or non-glutinous rice, is the type of rice typically used in Korean cooking and found as a side dish with meals. Chapssal, or glutinous rice, is the type of rice used in making rice cake, and familiar to many as sushi rice. Visual identification of mepssal and chapssal in dry grain form is easy, due to differences in starch content. Mepssal contains 80% amylopectin and 20% amylose and is mostly transparent. Chapssal contains 100% amylopectin and is an opaque milky white. Due to these differences in starch content, choosing between mepssal and chapssal when designing a recipe is of paramount importance. Use of mepssal in a recipe can impart a dry flavor, whereas chapssal can impart sweetness. Differences in starch content can also impact required soaking times. According to research done by the RDA, after washing the rice, mepssal should be soaked for a minimum of three hours, whereas chapssal should be soaked for a minimum of two hours.

Understand differences

between commonly used kinds of rice

- Glutinous rice(찹쌀) • Non-glutinous rice(멥쌀)



Contains 100% amylopectin



Contains 80% amylopectin & 20% amylose



B. WATER

As with any brewing, the quality of water used is of utmost importance. For homebrewers who may live in urban areas, checking the local content and quality of municipal supplies is essential. Filtering even city water through activated charcoal will provide a neutral basis for brewing, though it may lack of the additional complexity of natural spring sources. A chief concern is chlorination of water, which will adversely affect the microorganisms in the brew. While chlorine can be boiled off, the presence of chloramine, a more common contemporary way of disinfecting municipal supplies, must be rectified with use of campden tablets, also known as potassium or sodium metabisulfite. Use as directed.



C. NURUK: Korea's fermentation starter

Nuruk is Korea's traditional fermentation starter and is typically made of coarsely ground wheat that has been moistened, packed into a mold, and left to carefully ferment in a box packed with straw. In that fermentation process, the wheat brick is inoculated with wild yeasts, molds, and lactic acid bacteria. Each of these components contributes to the fermentation process and final flavor of the brew.

Unlike beer, wherein malted barley is the source of the enzymes that break down the cereals, the mold found in nuruk is the source of the enzymes used to brew makgeolli. During the nuruk fermentation process, the wheat provides nutrients for the mold. Through the mold's growth and development, various enzymes such as protease, amylase, and lipase are produced at the terminus of the mycelium. A panoply of mold varieties can be found in Korean nuruk, including the *Mucorales* responsible for producing protease (various *Rizomucor*, *Rhizopus*, and *Lichtheimia*) and the *Aspergillus* responsible for producing amylase (primarily *Aspergillus oryzae*).

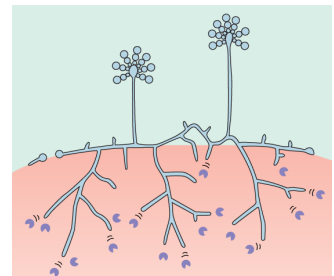


There are two dominant genera of yeast that are found in nuruk-- *Pichia* and *Saccharomyces*. Each genus of yeast can impart different qualities to the final brew. *Pichia* is the most common genus



and is primarily represented by the two species *Pichia jadinii* and *Pichia anomala*. *Pichia* is a top-fermenting yeast that can form a film across the top of the brew. Acetone is a notable by-product of *Pichia* yeast. The second type of yeast found in nuruk, *Saccharomyces cerevisiae*, is one common to beer brewing, and is found in lesser quantities than *Pichia*. *Saccharomyces cerevisiae* produces far more alcohol and imparts a harsher flavor than *Pichia* spp.

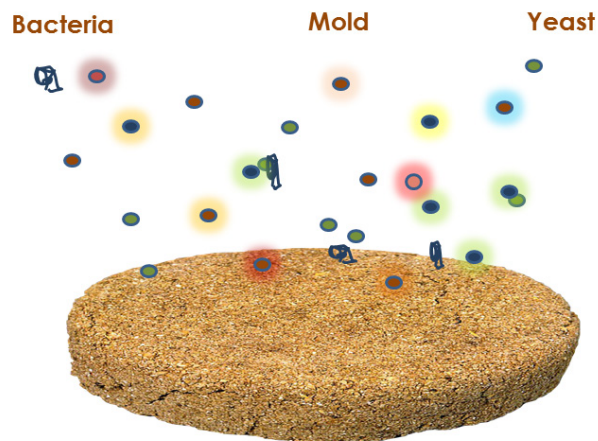
The third component of nuruk is lactic acid producing bacteria. There are several species of lactic acid bacteria present, most notably *Lactobacillus plantarum*, a probiotic bacteria that is common to many fermented food products, including sauerkraut, kimchi, pickles, sour dough,



II. Ingredients

yogurt, and some cheeses. The presence of lactobacillus is one reason that makgeolli is widely touted by news outlets as a health beverage, although the amount of volume necessary to receive an ongoing health benefit from either the fiber content of takju or the lactobacillus in live makgeolli would also render one an alcoholic.

Nuruk is a product of the local environment



Major enzymes in nuruk

Enzyme	Breaks down	Function	Final result
Protease	Proteins -> Amino acids	Allows amylase access to the starches in rice	Savory flavor
Lipases	Fat -> Fatty acids and glycerol		Aroma
Amylases	Starch -> sugars/glucose	Yeast use sugars to make alcohol	Sweetness



The exact compliment of molds, yeasts, and lactic acid bacteria in nuruk can depend upon the region where the nuruk was made. Also, different regions in Korea have unique methods of making nuruk that can affect the microbial content. For example, in the southern region surrounding Busan, nuruk is molded into a flat disk instead of the brick that is common to other regions. This difference in shape of the nuruk is to accommodate the warmer temperatures and humidity as well as prevent spoilage. As a result, nuruk made in the region surrounding Busan sometimes has a higher lactic acid bacteria content than nuruk made in other regions. Thus, the nuruk's terroir, or region of origin, can have an even more profound effect upon the final character of the brew than the region of the rice.

D. YEAST (Optional Ingredient)

The addition of yeast beyond that which is already contained within the nuruk is not a traditional decision. So why should one add additional yeast when there is already yeast in the nuruk? The addition of *Saccharomyces cerevisiae* to a brew can have a profound impact on the final flavor and alcohol content. In the end, the decision to add yeast is up each individual brewer, and after reading this section you will be aware of the pros and cons of adding or omitting additional yeast.

Nuruk already contains two types of yeast: *Pichia* and *Saccharomyces*. However, *Pichia* is the most dominant of the two varieties. As *Pichia* produces acetone as a by-product, a dominance of *Pichia* in the brew can lead to an overpowering acetone aroma in the resulting makgeolli. Also, *Pichia* does not produce as much





alcohol as *Saccharomyces* spp. An addition of *Saccharomyces cerevisiae* can reduce the dominance of *Pichia* in the brew and can thus reduce acetone aroma as well as raise alcohol content.

Also, the addition of *Saccharomyces cerevisiae* at the beginning of the fermentation cycle can control for a dominance of lactic acid bacteria. A plethora of lactic acid bacteria in the brew can contribute to overwhelming acidity in makgeolli, so an addition of yeast can reduce the acidity and make the brew taste sweeter.

In making your decision, carefully consider whether you prefer a sweeter or more acidic flavor profile. If you prefer sweetness, then you should add the yeast. If you prefer sharper tanginess, then you should leave the additional yeast out.



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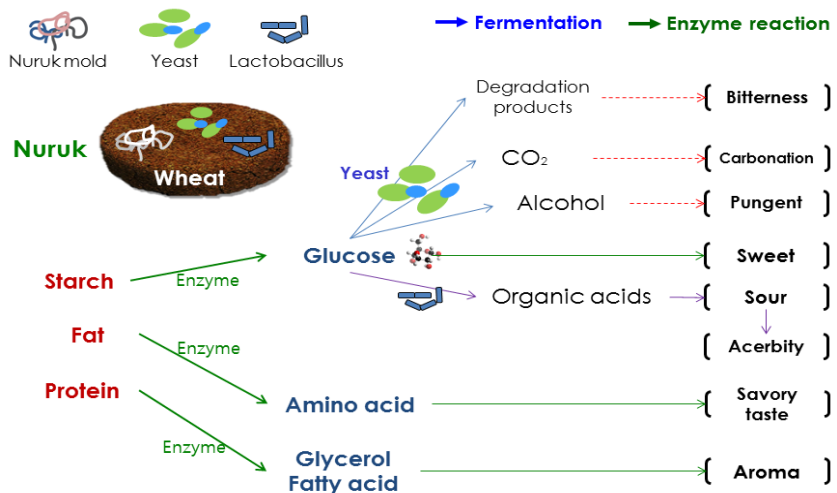
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III. Fermentation principles



III. Fermentation principles

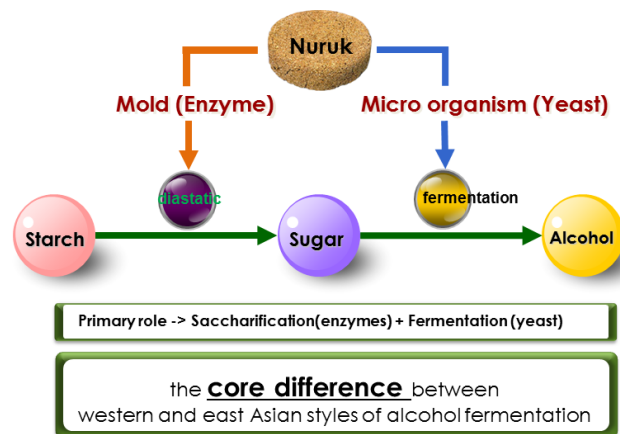
How do the three components found in nuruk (molds, yeasts, and lactic acid bacteria) interact with and break down the rice? Mold is the source of the amylase, lipase, and protease found in nuruk. These enzymes break down the larger starch, fat, and protein molecules found in the rice. The amylase converts the starch molecules (amylose and amylopectin) into sugar (glucose). The lipase breaks down the fats into glycerol and fatty acids (palmitic, linoleic, and oleic acids), which contributes to aroma. The protease converts the protein into amino acids, which contributes to an *umami*, or savory, flavor. The yeasts (*Pichia* and *Saccharomyces*) convert the glucose into alcohol, CO₂, heat, and contribute to bitterness due to degradation products (dead yeast). The lactic acid bacteria converts the glucose into organic acids, which contributes to the acerbity of the brew.



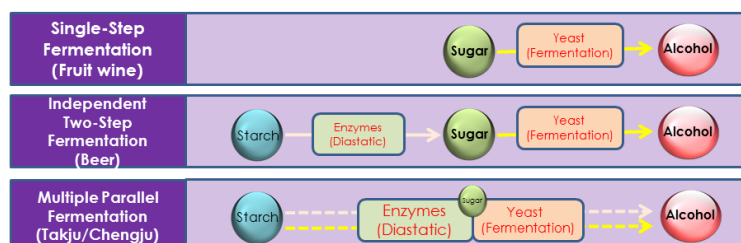


Unlike fruit wine, which consists of a single step fermentation (sugar to alcohol via yeast), or beer, which consists of an independent two-step fermentation (starch to sugar via enzymes, then sugar to alcohol via yeast), makgeolli consists of a multiple parallel fermentation, wherein the diastatic (enzyme) fermentation and alcohol fermentation occur simultaneously. This multiple parallel fermentation is what sets makgeolli apart from western styles of alcohol and likens it to other asian rice-based alcohols such as Japanese sake and Thai sato.

General fermentation principle



Classifications of types of alcohol fermentation





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IV. Methods & Materials



IV. Methods & Materials

A Note on Selection of Fermentation Vessels

Particularly in alcohol fermentation but a point to be noted in any fermentation is the vessel material. Acidic components of the fermenting brew will leach out any chemicals in the materials surrounding them. What makes alcohol so good at absorbing flavors and aromas for infusion also makes it adept at absorbing chemicals such as bisphenol-A, a shaping agent found in many plastics. While certain chronic toxins go between cycles of fear to cycles of complacency, our philosophy is to use the most stable and non-reactive materials possible to ensure a consistent brewing experience as well as reduced risk of exposure to potentially harmful chemicals. Food grade plastics





do exist, and brewers are encouraged to ensure that fermentation is explicitly intended for the suited use of any plastic vessel.

Brewing in glass is a favorite choice, with the caveat that decorative glass is to be avoided due to the commonness of lead in glazing. The note of caution about lead we extend to ceramic vessels as well, which have, in some cases, an advantage over stainless containers because they can be breathable, which allows for more efficient gas exchange and therefore a greater portion of the space in the vessel may be filled without risking overflowing during phases of expansion due to the production of carbon dioxide in the brewing process. Metal containers may be used, but they must be of non-reactive metals, and we emphasize the use of stainless steel. Do not use metals such as aluminum or copper, which can adversely react with the yeast and other microbes, affecting the character of the brew.

Brewers Beware

Reactive metals

Lead in glass containers.

BPA in plastic.





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V. Recipe: Danyangju

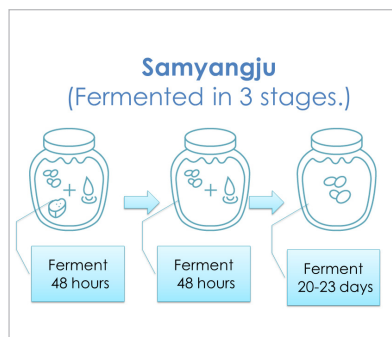
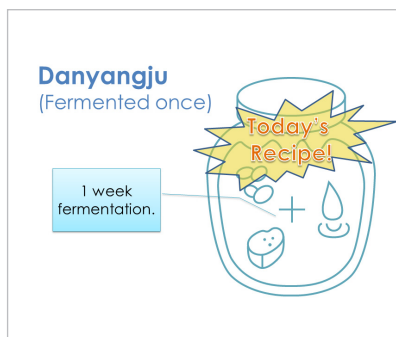


V. Recipe: Danyangju

Introduction in Context of Other Recipes

1. Primary fermentation: Danyangju.

A brief word on danyangju: the recipe below works as a stand-alone fermentation that will conclude in 7-10 days, depending on fermentation temperature. It also operates as a stepping stone to longer multi-step fermentations which will be covered in future articles. The number of stages is indicated in the name 'danyangju', which means a 'one-step alcohol'. An *Iyangju* would be a two step alcohol, and so on, using the Chinese counting system adopted for a variety of particular uses in modern Korea, eg, *il*, *i*, *sam*, *sa* and *o*. An *Oyangju*, or five-step alcohol, is typically where brewers agree the law of diminishing returns expresses itself, though theoretically an infinite number of successive stages are possible, each adding to the potential residual sugar content, ABV, and general complexity of the recipe.





***Note on our proprietary adjustments to the original recipe

The danyangju recipe as it is presented here is altered only slightly from its original form as found in a collection of food and alcohol recipes dating to 1726 CE, entitled *Eumsikdimibang*, which was originally anthologized as a wedding present from a woman to her new daughter-in-law.

As we have mentioned, temperature greatly affects the flavor of the recipe, and one way to influence flavor is to alter the water to rice ratios. We have altered the ratio of water to rice to 1:1 rather than the 1.2:1 of the original to retain a sweeter flavor, as more residual sugar will be concentrated in an equivalent volume of water, which also potentially improves the alcohol yield while retaining the tartness and smooth body characteristic of danyangju. Additionally, we have presented the option of adding a flavor-neutral brewer's yeast in order to discourage an outsized lactobacillus contingent, which flourishes especially at warmer temperatures and is a common source of too much sourness.

Bear these two alterations in mind as you discover your own preferred palate. We encourage you to compare recipes using the original ratio and we as recipes with and without the yeast addition. You will notice a stark contrast between all of them.

Finally, we recommend practicing the danyangju recipe repeatedly. After you have mastered the recipe, we recommend experimenting with flavor infusions.

V. Recipe: Danyangju

Equipment

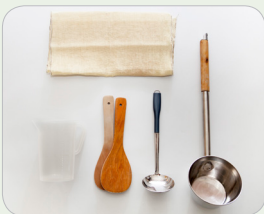
- Colander
- Large mixing bowl
- Smaller bowls for measuring (2)



- Scales for weighing ingredients



- Measuring pitcher (1 L capacity)
- Stainless steel ladle
- Large stainless steel scoop
- Hemp cloth
- Wooden paddles (2)



- Steamer
- Bamboo or silicon cooling mat



- Fine mesh filter bag
- Fermentation vessel
- Sanitizing spray bottle (can contain sodium metabisulfite solution or 70% alcohol)



Ingredients

- 1 kg chapssal (glutinous) rice





- 1 L water



- 3 g brewers yeast (optional)
- Pinch of sugar (optional)

- 90 g nuruk (Note: nuruk is commonly misidentified both in online resources as well as in Korean-English dictionaries as ‘malt’ or ‘yeast’. Only a small portion of the many varieties of nuruk are malted, or germinated by exposure to moisture, before grinding, and while nuruk contains a multitude of yeasts, neither malt nor yeast as individual ingredients fulfill the role nuruk plays in brewing Korean alcohols. It is also not in any way equivalent to koji, which should not be substituted in this recipe.)



STEP 1

Wash the rice.

Why wash the rice? Washing the rice is a great opportunity to remove dirt, pesticides, and excess starch residue from the outside of the grain, as well as pick out rocks, insects, and any other impurities. If the rice is not properly washed, the starch residue can contribute to excess turbidity in the final product, especially cheongju (clear yellow top layer).

V. Recipe: Danyangju

Measure the rice into the large bowl. Fill the bowl with cool water (not hot). It's important that the water not be of a temperature sufficient to start any breakdown of the starches. Altering the order or overall timeline outlined in the steps that follow will produce unpredictable results. After the rice is covered by a couple of inches, turn off the water. Spread your fingers and gently rake the rice in a circular motion, being careful to keep the grains intact (without breaking). Gently agitate the water and rice until the water is cloudy.



Placing your hand at the side of the bowl and pour out the turbid water into the sink, being careful to keep rice grains from falling out of the bowl.





Fill the bowl with water again and repeat the washing process as many times as needed until the water runs clear.

Halfway washed
[Still turbid]



Almost finished
[Still clear]



Finished
[Clear]



STEP 2 *Soak*

Cover the rice with an inch or two of water and soak for a minimum of two hours.

STEP 3 *Drain*

Drain the rice in a colander for 25 - 30 minutes.



STEP 4 *Make Godubap*

Godubap, or steamed rice, is one of several methods of preparing the rice for fermentation. Other rice preparation methods in the recipe literature include boiled rice (rice cooker method), ground rice porridge (*Juk*), whole-rice porridge (*Ssal-juk*), steamed rice cake (*Beksulgi*), thick boiled rice pudding (*Beombeok*), and boiled ground rice donuts (*Gumeongddeok*). The water content in each of these methods can vary significantly and can thus have a profound

influence on the outcome of the final brew. With a mastery of all seven rice preparation methods, a brewer will be able to execute almost any recipe in the literature. We include the godubap method in this primer for its ease and ubiquity in numerous recipes. We will cover the other methods in volumes to follow this one.

*****NOTE FOR THE HOMEBREWER**

The rice cooker method cannot substitute for the godubap method in this recipe. As rice cookers cook the rice via submerging the rice in water and boiling (as opposed to steaming), the resulting cooked rice is very different, both in water content and break down of the grain. We highly recommend investing in the equipment needed for steaming the rice, as the godubap method will appear again in recipes and volumes to follow this primer. For those who wish to start their makgeolli brewing explorations inexpensively, we highly recommend bamboo steaming trays (of the same type for making steam buns) that be found easily at any Asian market in the US or around the world. For those brewers who are more serious about brewing at larger volumes, stainless steel steamers can be found in almost any capacity.



- To begin, wet the hemp cloth under the faucet and then wring out the excess moisture.



- Line the steaming tray with the moistened hemp cloth, being sure to tuck in the corners.



- Fill the steaming tray with the rice that has been washed, soaked, and drained.



V. Recipe: Danyangju

- Fold the edges of the hemp cloth over the rice.



- Steam the rice for 40 minutes or until *al dente*. Start the 40 minute timer after you can see steam rising from the top of the steamer, as the steam indicates that the water below is boiling. The rice will be moist, glossy, and chewy when finished.



- To remove the rice from the steamer, flip the edges of the hemp cloth over the sides of the steaming tray and allow the cloth to cool. Twist both sides of the hemp cloth to use as a handle for removing the rice from the tray.





- Place the hemp cloth and steamed rice on a bamboo or silicon mat. Using the wooden paddles, gently break apart rice clumps and spread out on the hemp cloth. Cool the rice to 25°C.



*****NOTE :** It is necessary to cool the rice to 25°C in order to prevent denaturing the enzymes and killing the yeast. Failure to cool the rice at this stage can create problems in the fermentation process and can lead to a failed batch.

STEP 5

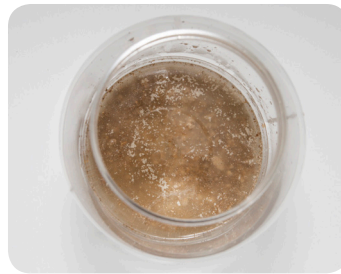
Sterilize the equipment.

While soap is a tried and true favorite for cleaning away pathogens, in a case where we want to create a favorable environment to a wide variety of microorganisms, we encourage our students to use a solution of 70% ethanol in water to sterilize any vessel or implements used in brewing, as well as any other contact surface whether it is the underside of an airlock or a strainer. This is because alcohol will always evaporate, rather than risking a poorly rinsed vessel to retain a residue of soap, which will kill any yeast or bacteria it comes into contact with. Two additional options include diluted iodine, and a solution of sodium metabisulfite, the latter of which is commonly used for rinsing glass before alcohol is bottled.

V. Recipe: Danyangju

STEP 6 *(Optional Step) Activate the additional yeast in a small bowl with a little warm water and a pinch of sugar.*

It is also of advantage to cooler brewing to allow the nuruk to awaken in a manner similar to isolated yeasts. Add a portion of the 1L of filtered water to the vessel holding the nuruk sufficient to submerge the rough grain. As with wakening yeast, it is normal to see some bubbling as the dormant microorganisms rehydrate.



STEP 7 *Put the cooled godubap, nuruk, water, and (optional) yeast into the fermentation vessel.*





STEP 8 *Incorporate Ingredients in the Brewing Vessel*

With a clean or gloved hand, mix the godubap, nuruk, water, and brewer's yeast together. Gently massage the mixture with the palms of your hand until the rice absorbs all of the water. Thoroughly incorporating and aerating the ingredients at this stage is important to a successful fermentation.



STEP 9 *Final Clean-up & Labeling*

Wipe down the sides of the inside of the vessel to remove any residue. Put on a sterilized lid. If the lid is a sealed screw top, unscrew the lid a quarter turn to allow CO₂ to escape. If your vessel allows, add a CO₂ lock and a thermometer. Wipe down and dry the outside of the vessel if needed. Label the side of vessel with your name, the recipe name (danyangju), the ingredients and amounts used, start date of fermentation, and projected finish date (approximately one week later).

Vessel prior to insides
being wiped down



Clean vessel





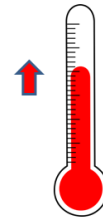
STEP 10 *Stir for 2-3 days and leave to ferment for approximately 1 week.*

Place the fermentation vessel in a room with an ambient room temperature between 18-26°C.

Temperature control is the key to success!



- Fermentation is **exothermic**.
- Add 5 degrees C to the ambient room temperature to get your approximate fermentation temperature.



How can you maintain your fermentation temperature in a suitable range?

Simple Methods:

- Water / Ice bath
- Evaporation technique



Advanced Methods

- Specially Purposed Refrigerator
- Homemade Icebox Chiller(Frozen jugs of water) & Computer Fan to Provide Air Circulation
- Temperature Controller/ Temperature Sensing Probe / Recirculating Pump



Stir the mixture well
 2 or 3 times per day for 2-3
 days. The reason for stirring in
 the first few days is that in the
 first phase of fermentation, it
 is important to oxygenate the
 brew (aerobic fermentation)

22 °C ↑

High temps = Off flavors.



+ chlorine
 + acetone
 + fruity
 + esters
 + fusel oils

to encourage the yeast colony to replicate. After 2 - 3 days, the yeast
 colony will be established and the brew will transition to an alcohol
 production phase (anaerobic fermentation).

Danyangju is usually ready after 1 week. However, the
 1-week fermentation time is a rough estimate, assuming that the
 ambient temperature is 24 degrees celsius. Higher temperatures will
 encourage faster fermentation; lower temperatures will encourage
 slower fermentation. Rather than following the strict time table of
 one week, we recommend watching your brew for signs that the
 fermentation is finished.



STEP 11 *Filter the danyangju.*

As the duration of fermentation can vary according to
 ambient temperature and other factors, it's important to identify when
 the fermentation is nearing completion. Look for three tell-tale signs
 that the fermentation is complete:

V. Recipe: Danyangju

You can tell the brew is ready if the rice breaks down easily between your fingers, you can see three layers of separation (with a middle layer of clear cheongju), and the CO₂ bubbling has slowed down.

Re-integrate the brew by stirring, and then use a clean stainless ladle or equivalent instrument to remove a small portion of the brew into a fine-gauge nylon filter bag. Avoid using cheesecloth, as it may not be of the necessary fineness, and as cotton may stick to the lees after filtering. Firmly but gently squeeze downward with one hand while stabilizing the upper portion of the filtering bag with the other. A good technique is to gradually twist the upper, empty portion of the filter bag as the fluid content is expelled. Massage the lees firmly enough to expel any residual water, but be cautious to not force out excess sediment through the filter bag.

Store the lees in a freezer or a refrigerator, where they will keep for further use. They may be included in soaps as exfoliants, used as marinades for meats because of the enzyme content, or used as a principal component in a deeply flavorful beverage called *Moju*, which is served hot in the wintertime as mulled wine is in some Western cultures, or cold in the summer, where its honey-sweetened, herbal tone and light alcohol content (often no more the 2% ABV) is ideal for refreshment. We have included this recipe in the appendix for the convenience of brewers interested in a waste-free brewing process.



How do you know if your brew is ready?

- Reduced CO₂ Output

- Grains on top break down easily(mush)

- 3 distinct layers



V. Recipe: Danyangju

STEP 12 *Bottle and enjoy!*

When refrigerated after filtering, danyangju will keep approximately 4 months. To serve as cheongju, allow the wonju to settle into two layers. Siphon off the upper layer for cheongju, and to make what is generally referred to as ‘makgeolli’, dilute the lower sedimentary layer with water to taste. At this point additional flavorings or mix-ins are possible, whether something as simple as using a sparkling spring water to enliven a takju with carbonation or to add a fruit concentrate. We recommend experimenting with both the cheongju and takju, as well as enjoying a mixed wonju on its own. Note that any dilution, of the takju particularly, will result in a dramatically reduced shelf life even when refrigerated.



VI. Conclusion & References for Further Learning/Supplementary Materials







VI. Conclusion & References for Further Learning/ Supplementary Materials

Q1 *How to flavor my makgeolli?*

The best method of flavoring your makgeolli will depend upon what exactly you plan to add to it.

If you wish to flavor your makgeolli with dried flowers, tea, spices, roots, or starch-rice flavorings (i.e. sweet potatoes, bananas, etc), we recommend including those ingredients in the steaming stage, when the rice undergoes the godubap process.

If you wish to flavor your makgeolli with fresh fruit, it should be added 3 to 4 days prior to filtering. If it is added any sooner than that the fruit may lose its fresh flavor as essential oils evaporate and sugars are transformed into alcohol. It's helpful, but not required, to freeze and defrost the fruit prior to adding it to your fermentation. Freezing the fruit causes the cell walls to burst, which will allow the fullest infusion of the fruit into the alcohol. Interestingly, the fruit flavor will be more apparent and will taste fresher if it is frozen before being added.

We do not recommend the tea method, wherein one makes an infusion of spices and water, then adding it to the godubap. The tea method will not result in a pronounced flavor in most cases.

If you are interested in adding a dry leaf tea or a powdered

VI. Conclusion & References for Further Learning/Supplementary Materials

tea such as Japanese *Matcha*, it may included in the steaming stage as well, or mixed in two days before filtering. Each will require different portions of tea, and the outcomes will be different. To call one practice better than another would be to ignore the flexibility of nuance an experience brewer can give by using such additions.

Aromatic spices and herbs, such as whole cinnamon bark, dried berries, or leafy plants such as mugwort, are also best included in the godubap stage.

Q2 *I've read that some people add sugar, honey, etc. after they strain their makgeolli. Do any of you recommend this or have any suggestions?*

The recipe should be designed as such that you shouldn't need to add syrup in order to make it drinkable. If you need to add sugar after filtering, then it's a sign that either something went wrong during fermentation (temps too high or the brew fermented too long) or that the water content in the recipe is too high. If your makgeolli is too sour, it can indicate that the fermentation temperatures were too high. In general, a recipe should have 1:1 or 1.2:1 water to rice ratio.

We recommend adding additional sugar only if your brew is unpalatably sour. I recommend first tasting the brew after filtering and then deciding if you need to doctor it. Keep in mind that additional sugar content can raise the abv, as the yeast will convert that sugar to alcohol. So if you do add additional sugar, do it just before serving.



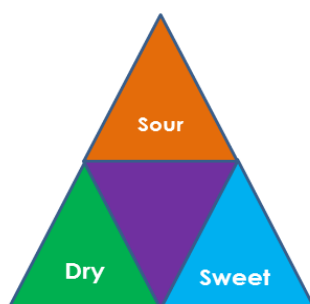
TROUBLESHOOTING - 4 of the most common problems faced in brewing makgeolli

To reiterate when planning for future batches: If you have recurring trouble with sourness, you should modify the brewing temperature or use a different recipe, and be sure that no step of the process, including sterilization, is being overlooked.

Common problems including a slow start, resulting in insufficient enzymatic breakdown. This may be due to adding water that is colder than room temperature in the initial mix.

A smell of acetone may be present if too much *Pichia* yeast is present, though this can be easily remedied with vigorous stirring repeated twice daily for one or two days following the appearance of such an odor, ceasing when the odor abates.

Balancing the brew



- Low Residual Sugar
- Mepssal
- Age

- High *Lactobacillus*
- High Fermentation Temps
- High Water Content

- High Residual Sugar
- Low Water Content
- Chapssal
- Addition of Yeast

VI. Conclusion & References for Further Learning/Supplementary Materials

An overly sour brew is likely caused by a warm fermentation of 25°C or higher, which often encourages a disproportionate amount of lactobacillus. This can be discouraged through the inclusion of 3 g of a brewer's yeast in the initial mix, or by lowering the fermentation temperature.

Colder fermentation conditions can delay the readiness of this recipe for several weeks, but despite this, the resulting danyangju will be richly flavored and much stronger than a shorter term fermentation. As with many other variables in brewing Korean alcohol, we encourage experimentation with various brewing temperatures, as each will encourage different populations of microbiota and therefore produce a slightly different result.



USING THE *Jigemi* (LEES) AFTER FILTERING

How to make moju



Ingredients:

1/2 asian pear(배), 30 g licorice(감초), 3 L water(물), 50 g honey(꿀),
50 g Oriental raisin tree(*Hovenia Dulcis*/헛개나무), 200 g jujube(대추),
500 g jigemi(leftover from the makgeolli/지게미), 50 g ginger(생강),
and 50 g cinnamon sticks(통계피).

- ❶ Deseed the jujube.
- ❷ Put all ingredients in a pot except for jigemi and honey; boil for 30 minutes at high temperature.
- ❸ When the water has reduced to about 2 L (2/3 of the original volume), add the jigemi to the pot and simmer on low for 10 minutes.
- ❹ Filter the boiled moju.
- ❺ Add honey to taste.
- ❻ Keep the moju refrigerated. It will keep for 1 month. Heat and serve as desired.

Answer credit: Sin Yeonwoo and
http://navercast.naver.com/magazine_contents.nhn?rid=1095&contents_id=32795

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We also gratefully acknowledge the many journalists and production crews over the years who showed an interest in our interest and proved that not all media teams are a nightmare. Particular thanks to the extensive attention of Erik Moynihan and Tiffany Needham of Semipermanent, and their excellent production and support team, including Tori Allen, Jen Moeller of Pudding Pop Media, Jin Min of Minimize Productions, Adam Hobbs, and Lee Min Jae, as well as Choi Haeng-suk for allowing us to visit her brewery in Paju, to Jeong Jae-cheol for expanding our experience with makgeolli by showcasing the use of rare wild rice in his brewing; to Lee Sang-heon for his hospitality and expert brewing in Asan; and to the many, many craft brewers taking an active role in revitalizing this aspect of Korean culture and challenging both tradition and modern industry to develop the unique products they are proud to stand by.



Additionally, we have had great support from the Rural Development Administration(RDA), which has been a pillar of contemporary makgeolli research and in supporting domestic agricultural industries generally, and whose selfless devotion to research has resulted in a wide variety of recent patents on methods including brewing processes and isolation of yeast strains for the betterment of the entire industry.

A brewer would be nowhere without a place to share, and a long time supporter of the craft makgeolli industry has been Paik Ung Jae, the inventive and enterprising owner of Hongdae's Tricycle Bar, an excellent showcase of both the effort to expand the food pairings of modern Korean cuisine and the alcohols that go with it.

Our thanks would be entirely for want without an emphatic mention of Monica Kluge, founder of MMPK, currently directed by our dear friend, the indefatigable and possibly superhuman Julia Mellor, master of all things in society about makgeolli, and her right hand Dan McLaughlin whose constant spirit keeps us afloat and optimistic, our resident nuruk specialist and pillar of support Emily Carroll, and our friend and teammate Sarah Carlisle. We owe a great debt to Kim Jaewoo, Sin Yeonwoo, and the staff of Muldwinda for hosting us so many times of the years, and to Bae Youngho of the Bae Sang Myeon Brewery for their invaluable guidance and encouragement.

Rich Aquino of Vino Aquino in Tacoma, Washington State, was our earliest mentor and introduced us into the deep and storied world of wine and alcoholic fermentation, and still makes the best dry cured sausage we have ever tried. We thank our families in particular, for supporting us throughout our time in Korea and whose enthusiasm has helped to keep us both pushing ourselves towards unexpected and challenging goals while enduring our absence from homes that they often remind us would be all the more welcoming were we present.

Though Korea is often called, and calls itself, a Confucian nation and culture, it owes a great deal of its contradictory and passionate character to the unkempt wildness of its shamanistic roots, and in that vein, given that one may exhaust words without ever really reaching the root of what's meant and overlooking great and subtle importance, it is perhaps fitting to conclude by paraphrasing East Asia's own legendary trickster, Lao Tzu, and say this: what you take from this book is what you mix, brew, and taste - and when you do, all the words in the world won't get to the root of it.

Gambae!

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