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Abstract

Sake is the traditional alcoholic beverage of Japan and was first made at least 2,000 years ago. From its origins as the "drink of the Gods" to its current status as one of the most popular drinks in the country, the history of Sake is steeped in tradition, innovation, and custom. Similar to Beer which presumably has its origin in steeped breads made of cereals, the source of Sake was steamed rice - the staple food of Japanese people. It must be assumed, that in both cases some remains of dishes were forgotten and during a few days with high humidity and convenient temperatures microorganisms could affect the carb and produce low amounts of alcohol. During the centuries with continuous improvements the contemporary high quality characteristics of Beer and Sake could be achieved. Though Sake often is designated as "Rice Wine" today's production facilities are called breweries. Anyway the technology is complete different to beer production depending on the fundamental disparities of the raw materials. Finished rice has no enzymes but only natural starch and some protein and is not suitable for mashing and following fermentation. So parallel modifications by different microorganisms must care for the production of low molecular carbohydrates and a-amino acids and the fermentation process.

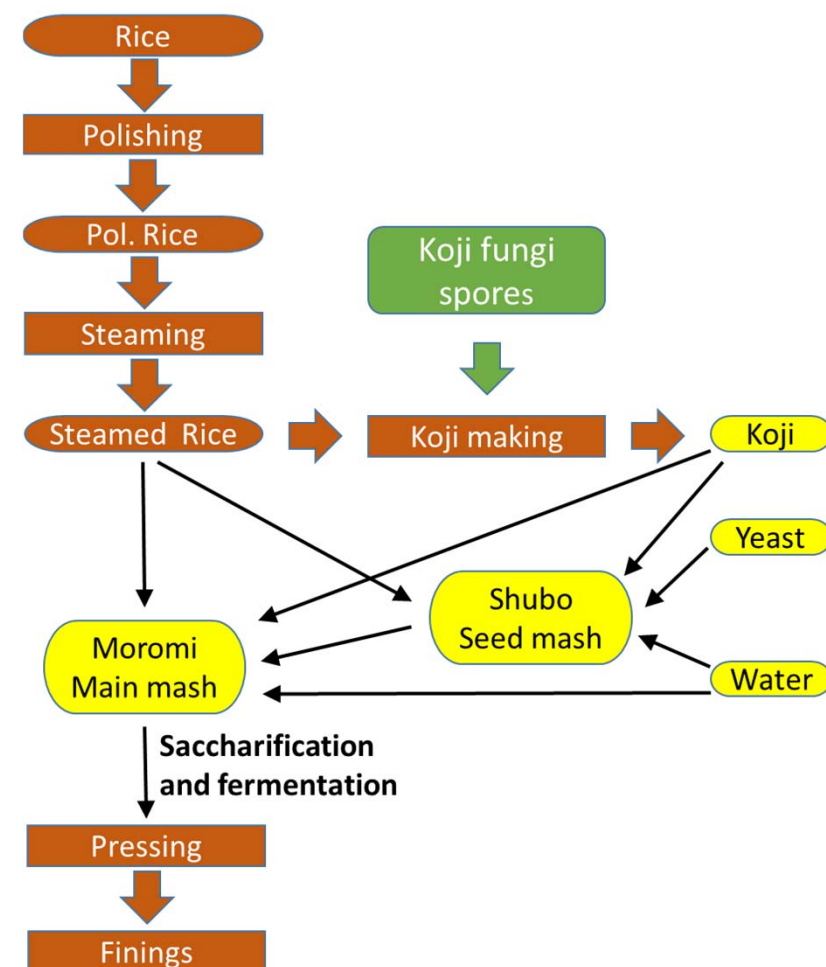
Aspergillus flavus var. oryzae –the allrounder

The degradation both of starch and protein is operated by a special microorganism: *Aspergillus oryzae*. This filamentous fungus has amazing enzymatic power – amylases, proteases and even cellulases are secreted during growth and allocate the required low molecular substances. Fortunately *A. oryzae* lacks expressed sequence tags for the genes responsible for aflatoxin production. So it's considered to be a safe organism and serves as provider for enzymes in the pharmaceutical industry (many different compounds are offered by the manufacturers). Moreover it's widely used in food production and used for fermentation of soybeans, production of miso and other traditional Japanese foods. Sake brewing would not be possible without this universal remedy.

Basics

Based on raw materials and steps in production the fundamental difference of brewing Beer and Sake becomes obvious. In the case of Beer, the low molecular substances for fermentation and yeast nutrition are allocated by the enzymes of malt. In Sake production these tasks are undertaken by a microorganism. As the whole process is executed with temperatures of 10-15°C, the enzymatic degradations lasts longer and demands that both the supply with low molecular substances and their fermentation as well has to be executed simultaneously. Therefore the production of Sake is named „Parallel Combined Fermentation“

Procedure



Making Koji – the primary matter of Sake

Rice is polished to a ratio of 65 or even 50%. Afterwards it's steeped, set above a pot with boiling water and steamed about 60 min. During this time it's sterilized and the starch is partly gelatinized. After cooling to 32°C it is inoculated with the fungi spores and placed in the koji chamber during 48 to 55 h. By adjusting temperature and humidity the growth of the fungus is directed to penetrate deeply the kernels in order to allocate enzymatic power not only on the surface. Thus different qualities of Koji suitable for low or high quality Sake can be achieved. Following this, Koji is dried on sheet papers and stored for a few days till further use.



After 20 hours



after 44 hours (completion)

Shubo – the starting culture

Koji tastes pretty sweet already. This means that the amylases have allocated enough low molecular substances for starting the fermentation. So Koji and more steamed rice are mixed with water under addition of yeast to a starting culture – the so called Shubo. Parallel saccharification and fermentation starts and goes on. After 7-9 days at temperatures starting with 10°C and final 18°C the concentrations of yeast cells is high enough for further dilution.

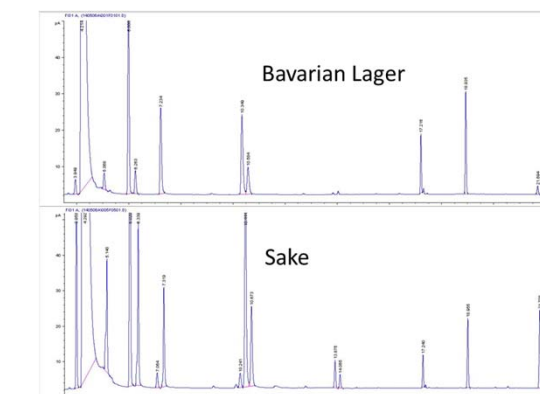
Moromi – the final mash

For preparing the main mash Moromi, all Shubo, additional Koji, steamed rice and more water are mixed together in the final fermenters. In 2 following steps more Koji, steamed rice and water is added up to the final volume. Moromi is stored till the end of fermentation. Going on with temperatures of approx. 10°C it takes about three weeks until the desired alcohol content of 19-21% is achieved. Next, the entire content of the Moromi fermenters is pressed in constructions comparable to mash filters. Fresh Sake is diluted to the desired alcohol concentration and treated with several methods of finings according to the special needs which differ from brewery to brewery.

Quality aspects

Similar to Beer the taste of Sake highly depends on the quality of the raw materials. Only purest water and special rice varieties are suitable for production. Selected yeast strains are necessary to achieve the high alcohol concentrations and the desired aroma profiles. Moreover the different procedures of making Koji have central significance.

Analyses



The headspace plots of Beer and Sake are similar, but differences in concentrations are obvious. Sake shows some peaks that are not detected in Beer and could not be identified until today. More investigations should be carried out to add to this data and provide clarity.

Impressions of Sake Brewery



polished rice



Koji room



Moromi fermenters



press

Links

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