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Original article

Japanese *sake* and evolution of technology: A comparative view with wine and its implications for regional branding and tourismQ18 Jun Sato ^{a,*}, Ryo Kohsaka ^b^a Japan Economic Research Institute, JapanQ1 ^b Graduate School of Environmental Studies, Tohoku University, Japan

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A B S T R A C T

We analyze the trends and status of Japanese *sake* (frequently referred to as *Seisyu* in Japanese academic contexts). The flavor of *sake* has improved in recent years and demand for *sake* is on the rise globally. Our analysis is based on a review of literature and secondary data examination of existing statistics. The results support quality control of *sake* both domestically and internationally. Quality control is achieved through the removal and use of acid from polished rice and additives such as alcohol. One use for acid may be for rice flavors, which are regionally specific and therefore may lead to a reconsideration of geographical indications. The use of acid and collaboration with the local and regional community is observed in wine production. Similar processes are observed with Japanese *sake*, and this implies that wine and *sake* may have similar futures. Visits to *sake* breweries have potential in the spheres of tourism, regional branding, and destination management.

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1. History and characteristics of *sake*

The history of *sake* is ancient and descriptions are found in *kojiki* (古事記) and *nihonshoki* (日本書記). *Sake* originates from mainland China. The brewery technology in Asia was relatively well established and the Song dynasty [1] in China (中国宋代) was able to produce the low temperatures necessary for brewing a few hundred years earlier than Pasteur did in Europe (around 1865). Chinese brewing technology was traditionally applied to *sake* production in Japan (around 1570) [2].

The technology produced immature flavors. Due to this fact, the evolution of *sake* was slow during the Christian missionary period [3] from the 16th to the 19th century.

The limitations would eventually give way to excellent technologies that overcame such difficulties, but it was not until recent years that production of a relatively high standard in flavor was realized. This development has been rapid recently. For example, 78 labels of *sake* were awarded scores of above 90 points by the Robert Parker group in 2016, which is equivalent to the scores received by deluxe Bordeaux wines [4].

The reputation and demand for high-quality *sake* are rapidly increasing. These improvements are thanks to better malt and

yeast, rice polishing technology, and the know-how of producers with increased access to state-of-the-art scientific knowledge and new production technologies.

Such characteristics become clear when *sake* is compared to wine. The process of producing wine is relatively simple and it has an old history, with established production methods. For example, the Bordeaux Primary Chateau rated by the Napoléon III in the mid-19th century is produced under the same system now as it was then.

According to genetic analysis, wine yeast originates in Mesopotamia and was transported to Europe. Around 10,000 BC, the route split into the Danube river basin (central Europe) and the Mediterranean coast (Italy, Spain, France) [5]. The process of brewing was repeated using yeast with stable, cellar-fermented grapes, which allowed for high-quality wine to be produced in regions housing famous factories. The number of cultivated yeasts (培養酵母) continues to increase but natural yeast, usually of a particular brewing house (自然酵母), is typically used today.

The quality of grapes is also influential in the overall process. The geographical indication and *Terroir* have special meaning in wine because the history (酵母) and nature of the grapes underpin their flavor expression.

Compared to wine, *sake* is complex to produce. Improving the flavor of the drink requires modern scientific technology in addition to traditional methods. The rice first needs to be saccharified (糖化) by the malt. It was during the Muromachi period

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(1336–1573) [6] that malt began to be produced stably. The production of malt was regarded as a kind of secret recipe made available exclusively to a select group. It was during the Meiji period (1868–1912) that malt became widely available and scientific analysis of it was possible. Today, malts that are specific to certain products such as *junmai ginjo-shu* (純米吟醸酒) or practical use of *seisyu* of white *koji* for distilled spirits, have developed, and progress in recent years has been fast [7].

The changes are especially rapid for the yeast that serves for alcohol fermentation after saccharification. Separation of the yeast for *sake* occurred around 1893, which is similar to 1893, but the yeast obtained during the period is not in use today. The most ancient yeast in use, number 6 yeast (which originates from Akita; 秋田・6号酵母), was separated around 1930. Furthermore, the yeasts for *sake* evolved rapidly and adapted to the changes in the quality of *sake* in the post-war period (after 1945).

The breakthrough occurred in 1953, with number 9 yeast (9号酵母), which was fit with less acid and a more robust flavor. The yeast contributed to the development of *Sake* and has been refined and improved to form the 1801 yeast (1801酵母) of 2006 [8] (Figs. 1–3).

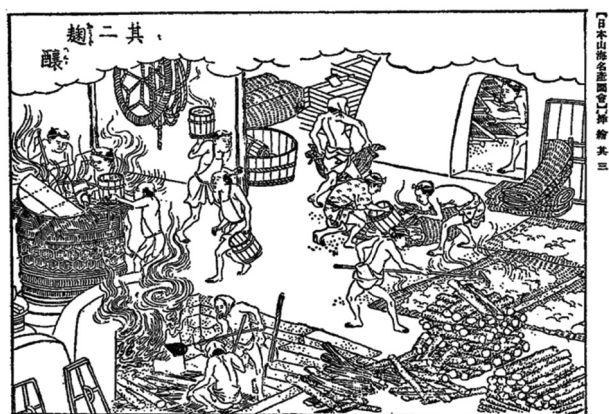


Fig. 1. *Sake* brewing in the Edo Period (19th century). The traditional process of production of *sake* is shown in the figure. Traditional equipment of *sake* production can be seen in the historical drawings. The process and equipment are changing; however, historical materials are expected to be sources of current innovation.



Fig. 2. *Sake* brewery and its street in early Showa period when number 6 yeast (originating in Akita) (秋田・6号酵母) was found. Rapid motorization was seen in Japan in Taisho and early Showa period. The modal shift changed streetscapes, networks of supply of *sake*, and relationships between producers and consumers. The relationships between producers and consumers are rediscovered in the current branding activities of *sake*.



Fig. 3. Traditional *sake* factories (蔵元) using number 6 yeast. Traditional equipment of *sake* production is often made of wood. In this context, forestry is one of the industries that can collaborate with *sake* production. Multiple industries including tourism can collaborate with *sake* production in terms of regional development.

In more recent years, yeast that will increase the acid, rather than decreasing it, is being developed and contributing to the development of *sake* flavor [9]. Recent improvements to yeast are attributed to the special treatment of technological processes that enable mate yeast to be isolated from the brewing environment. Q11

In other words, improvements should not be attributed to the history of factories (蔵元) or coincidence but rather to evolving scientific methods in the laboratory [10].

2. Challenges to improving the flavor of *sake*

In the 21st century, the flavor of *sake* has started to evolve and become widely accepted. Before that era, there were several large challenges. The impact of the lactic and succinic acids was often so strong that it made it difficult to drink *sake*. Two strategies were adopted to alleviate the impact of these acids. The first strategy was to warm the *sake* in order to balance the lactic and succinic acids.

According to Shimazu et al [11], an expert panel conducted a sensory evaluation to examine the level of acidity and taste of *sake* (呈味質) at different temperatures using three main components of organic acid (lactic, succinic acid, malic acid) and minor

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