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DECEMBER 5-7, 2024**

**LONDON
2024**

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TECHNICAL SCIENCES

UKD 663.4

TECHNOLOGICAL FEATURES OF SOUR BEER PRODUCTION USING WILD YEAST

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Abstract. The main features of sour beer technology have been identified. This type of beer is gaining increasing popularity among consumers due to its unique organoleptic characteristics, such as the use of wild yeast and bacteria isolated from the environment, spontaneous wort fermentation at temperatures of 20–25 °C for several months to several years, and an alcohol content in the finished beer ranging from 8 to 12% ABV. Methods of cultivating wild yeast, processes occurring during primary wort fermentation and the maturation of young beer, the main technological stages, and selected technological regimes for sour beer production, including the starch hydrolysis process, have been studied. A comparative characterization of various styles of sour ales using honey, fruits, berries, sugar syrup, and spices is presented.

Keywords: wort, beer, brewing, yeast, microorganisms, fermentation, brewing fermentation.

Brewing has a long history. In the past, most beer was produced through

fermentation involving various microorganisms rather than exclusively cultured brewing yeast. A sour taste was likely an important and common feature of beer throughout its history. Hops began to be widely used only in the last 900–1000 years, and since then, its bitter and aromatic varieties have become the main raw material for beer flavor formation due to their bacteriostatic properties, which limit the growth and activity of certain bacteria [1].

Sour beer, attractive for its variety of flavors and aromas, is gaining increasing popularity among beer culture enthusiasts. This unique beverage is distinguished not only by its tartness but also by a complex flavor bouquet combining fruity, berry, spicy, and vinous notes.

The technology of sour beer production has its own characteristics and consists of several stages. Beer is made from grains that primarily contain starch, which yeast cannot assimilate. Therefore, before fermentation, starch is hydrolyzed by amylolytic enzymes into reducing sugars, which are fermentable. There are two methods of wort fermentation:

- Top fermentation (warm fermentation)
- Bottom fermentation (cold fermentation).

Known brewing yeast strains differ in many properties and were previously considered separate species:

- ***Saccharomyces cerevisiae*** (top fermentation)
- ***Saccharomyces carlsbergensis*** (bottom fermentation)

Bottom-fermentation yeast is active at temperatures of 6–10 °C, while top-fermentation yeast operates at 14–25 °C. Bottom-fermentation yeast exhibits flocculating ability, settling at the bottom of the vessel after fermentation, forming a dense sediment. Top-fermentation yeast rises to the surface of the fermenting wort, forming a so-called "cap."

Wild yeast refers to microorganisms that naturally enter the wort from the environment, including air. However, when brewers isolate wild yeast independently or purchase it from commercial laboratories, beer made with it is called "wild". Such beer is not always sour and often results from mixed fermentation, in which

traditional brewing yeast and other microorganisms are used [1].

The main feature of sour ales is the process of spontaneous fermentation. Traditional sour beer preparation involves using wild yeast and bacteria present in the environment, including on the surface of hop cones. Instead of strictly controlling the process, brewers rely on natural changes, making each batch of sour beer unique [2].

Sour ale includes various variations and substyles, among which the well-known ones are "Berliner Weisse", "Gose", "Flanders Red Ale", "American Wild Ale", and others. Each has unique features and a history of origin.

Some styles of sour ale may be sweetened or enhanced with additional flavor accents, formed both during production and serving. Sweetening during serving typically involves adding certain ingredients directly to the glass before consumption. Below are well-known methods and ingredients used to create sour ale:

Honey: Adding honey to the glass can provide natural sweetness and aromatic notes that pair well with sour beer varieties.

Fruits: Adding fresh fruits such as berries (raspberries, strawberries, blueberries) or citrus fruits can not only sweeten the beer but also add additional fruity aroma notes.

Sugar syrup: In some cases, sugar syrup may be added to reduce the beer's tartness and increase its sweetness.

Spices: Sometimes spices like cinnamon or ginger are added to ales to balance acidity and create new flavor dimensions, though this is not direct sweetening but enhances the beer's taste profile.

These methods may be used for both classic styles (e.g., "Berliner Weisse") and new interpretations of sour ale where a more balanced flavor profile is desired.

This category includes traditional sour beer styles of Europe, predominantly (but not exclusively) made with wheat. Most of them have low bitterness, with acidity serving as the balancing element instead of hop bitterness.

Berliner Weisse: A very light, low-alcohol German wheat beer with refreshing clean lactic acidity and strong carbonation. A slight bread dough maltiness supports the acidity, which should not appear artificial. Brettanomyces aroma is restrained (if

present) [3].

Flanders Red Ale: A sour, fruity, vinous ale in the Belgian style with diverse malt and fruit nuances. Its dry finish and tannins emphasize its similarity to fine red wine [3].

Oud Bruin: A malty, fruity, aged, slightly sour brown ale in the Belgian style [3].

Lambic: A rather dry, often "funky" Belgian wheat beer where acidity balances the absence of hop bitterness. Traditionally brewed near Brussels through spontaneous wort fermentation without additional beer carbonation. The resulting beer's refreshing tartness makes it an excellent beverage [4].

Gueuze: A complex, pleasantly sour yet balanced wild Belgian wheat beer with very high carbonation levels, contributing to its freshness. Spontaneous fermentation provides it with an extraordinarily interesting and complex profile featuring hints of bread, horse blanket, leather, interwoven with citrus-fruit notes and acidity [5].

Fruit Lambic: A complex, fruity, pleasantly sour wild wheat ale, fermented with diverse Belgian microflora, featuring unique fruity tones that harmonize with its "wild" character. After fermentation and aging, its fruity profile often differs from fresh fruit aromas and flavors.

✓ Sour beer typically contains around 7% ABV and is ideally served chilled, especially in hot weather. This beer style pairs wonderfully with various dishes, such as cheese, vegetables, meat, and others.

✓ Most brewers offer diverse sour ale variations. Some produce beverages in classic styles like "Berliner Weisse," "Gose," and "Flanders Red Ale," while others experiment with different ingredients, wild yeast types, and technological regimes, creating unique beer varieties.

✓ The process of producing sour beer using wild yeast is similar to producing classic beer styles with cultured yeast strains. However, there are differences and specific features of sour beer technology, including:

✓ **Malt:** Sour beer production uses malt with low protein content,

promoting increased acidity and ensuring stability during storage.

- ✓ **Hops:** Aromatic hop varieties are used to give the beer a unique aroma.
- ✓ **Wort production:** Mashing and boiling wort are carried out for extended periods to caramelize sugars and achieve a more sour taste.
- ✓ **Cooling:** After boiling wort with hops, it is cooled to 20–25 °C (spontaneous fermentation temperatures).
- ✓ **Fermentation:** Wort is fermented by spontaneous fermentation microorganisms for several months or even years.
- ✓ **Maturation:** After fermentation, beer is aged in oak barrels for several months or even years.

The uniqueness of sour beer lies in the use of wild yeast and bacteria entering the wort from the environment and the spontaneous fermentation process at 20–25 °C. The resulting beer differs from classic types with its unique flavor properties. Due to the long fermentation process (lasting several months to several years), the beer acquires a complex and rich taste with tartness, fruity, berry, spicy, and even vinous notes. Spontaneous fermentation ensures the uniqueness of each batch. Its duration depends on the type of wild yeast and their concentration in the propagator.

- **Sour taste:** The sour taste is the most characteristic feature of sour beer. It arises from spontaneous fermentation used in its production.
- **Fruity aroma:** Sour beer typically has an intense fruity aroma, contributed by aromatic hops during wort boiling and added fruits.
- **Strength:** Sour beer usually contains alcohol in the range of 6–12%.

Conclusion. Sour beer is a real find for beer culture enthusiasts seeking new flavor horizons. Its unique sour and fruity taste, arising from spontaneous fermentation, makes this drink special and memorable. Sour beer impresses not only with its complexity and diversity but also offers a great opportunity for experimentation with different styles and flavor combinations. For those looking for something new and interesting, sour beer is undoubtedly an excellent choice.

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