A Review of Studies on the Brewing Process of Italian Grape Ale

Delin Han 1,a,*, Fangyuan Deng 1,b, Jianghua Zhao 1,c, Huiquan liu 1,d

1School of Bioengineering, Qilu University of Technology (Shandong Academy of Sciences), Shandong, 250353, CN;

a 10431221332@stu.qlu.edu.cn, b 10431221333@stu.qlu.edu.cn, c 10431221343@stu.qlu.edu.cn, d 10431221288@stu.qlu.edu.cn

Abstract. Beer is one of the most consumed alcoholic beverages in the world, and in order to satisfy people's attraction to novel smells and tastes, the variety of beer is constantly enriched. Fruit beer has a unique flavor and taste brought by the use of fruit varieties, which can bring a good experience to consumers. Italian Grape Ale (IGA) is a new kind of fruit-flavored beer produced by adding grape matrix, which is more and more popular among people. This paper firstly describes the brewing process of Italian Grape Ale, the selection of raw materials, the selection of grape varieties, the addition method and the amount of addition. It is hoped that this review will provide the reader with an in-depth understanding of Italian grape ale and trigger further developments in this field.

Keywords: Italian grape ale; brewing process; grape must addition method; grape must addition volume.

1. Introduction

Beer is one of the most popular alcoholic beverages in the world. [1]. With the craft beer revolution, there is a growing interest in new types of beers, especially the addition of fruits as adjuncts to beer, which allows for the brewing of fruit beers with distinctive and nutritious flavors [2]. In 2015, the Beer Judges Certification Program (BJCP) identified a new fruit style of beer by the name of Italian Grape Ale. Italian Grape Ale is a type of beer that is sometimes refreshing and crisp, depending on the grape variety used, and sometimes displays complex flavors [3]. In recent years, many Italian craft breweries have produced this beer. Due to the wide variety of grape varieties throughout Italy, the addition of grapes as an accessory to the beer is often considered as a specialty beer of the brewery's product [4]. This paper focuses on the brewing process of IGA beer, the selection of raw materials, the selection of grape varieties, the method of addition and the amount of addition.

2. IGA Beer Brewing

2.1 Brewing process of IGA beer

IGA beers are brewed with water, malt, hops, yeast and grapes or grape matrix, where grape matrix can be grape must [5], grape pomace [6] and grape skins [7]. Most of the brewers mostly use grape must for brewing IGA beers, so this paper focuses on describing grape must addition for brewing IGA beers. IGA beers are brewed through the processes of mashing, filtering, boiling, whirlpool, cooling, fermentation, storage, pasteurization, bottling and finished beer. Among them, grape must can be added at boiling, whirlpool, fermentation and storage (as shown in Figure 1). In the brewing process of fruit beers, the most critical point is the stage of grape addition and the amount of grapes added.
2.2 Selection of Raw Materials

2.2.1 Malt selection

Malt is the most important raw material in beer brewing, and its characteristics can not only determine the style of the finished beer, but also determine the quality of the finished beer. The types of malt are divided into basic malt and special malt. Base malts include pilsen malt, ale malt, vienna malt and munich malt. Base malts are not only high in sugar, but are also rich in enzymes and can be used in the brewing process in amounts up to 100%.

Specialty malts undergo special roasting techniques to differentiate them from the base malt in terms of color and aroma and have fewer fermentable sugars than the base malt, and specialty malts are used mainly for the purpose of regulating the color and aroma of the beer [8]. Specialty malts are subdivided into colored and non-colored malts. Colored malts include crystal malt, dark malt, amber malt and chocolate malt. Non-colored malts include nude malt, lactic acid malt, and melanoidin malt, among others.

So it is recommended to use pilsner malt or pale malt, this is because it is easy to highlight the aromas of the grape variety [3].

2.2.2 Hop selection

Hops are dioecious herbaceous plants [9], which are one of the important raw materials in the brewing process of beer and have an irreplaceable role in the brewing of beer. Hops are known as the "soul of beer" because they have good antibacterial and antiseptic properties, maintain foam stability, and provide soft bitterness and exuberant hop aroma. Hops are rich in flavor substances [10], and currently, more than 400 components have been identified from hop essential oils, and some studies have predicted more than 1,000 compounds [11]. At the same time, the biotransformation of hop flavor substances in the brewing process also affects the flavor of hops in beer [12], so the selection and addition of hops are crucial to the flavor of beer products. Hops are classified into aroma hops and bittering hops. Aroma hops are mainly used to increase the aromatic flavor of beer and give it a special aroma. Bitter hops have a high α-acid content and are mainly used to increase the bitterness of beer [13]. In recent years, with the cultivation of varieties of hops, bitter and aromatic hops have emerged. These hops are characterized by prominent hop aroma and high alpha acid content, and are mostly used as aroma hops in the brewing process. Each type of hop has its own unique flavor and produces a variety of beer styles. For the addition of IGA beer
hops, all kinds of hops can be used, but care should be taken to keep the dosage small so as not to mask the characteristic flavor of this type of beer.

2.2.3 Yeast selection

Yeast is the fermenting agent in the beer brewing process and is capable of converting fermentable sugars in the wort into ethanol and carbon dioxide and producing a large number of volatile organic compounds. For example, alcohols, esters, organic acids, carbonyl compounds, sulfur-containing compounds, and other flavor substances [14]. Depending on the type of beer fermentation, yeast can be categorized into ale yeast and lager yeast, which are obtained at different fermentation temperatures (16-24°C and 6-15°C), respectively [15]. For the choice of yeast, Giovanni De Francesco et al. [16] recommend the use of neutral yeasts, which can better reflect the aroma characteristics of the grape variety.

2.2.4 non-Saccharomyces selection

As beer has become more innovative, non-Saccharomyces have come to the forefront of brewers' minds. The use of non-Saccharomyces can reduce the ethanol content of beer, improve the mouthfeel of beer, increase the flavor of beer, and give beer diverse regional characteristics [17]. Earlier it was generally believed that non-Saccharomyces were microorganisms unsuitable for beer brewing, but as modern research continues, people has been found that some non-Saccharomyces can change the composition and content of beer flavor substances, thus improving the taste of beer [18].

Currently, of the non-Saccharomyces species involved in beer brewing, brettanomyces bruxellensis is the most common non-Saccharomyces [16]. Some brewers choose to age their beer in wooden barrels, which are usually second-hand barrels. These used barrels will usually have brettanomyces bruxellensis. Brettanomyces bruxellensis is considered an important part of the flavor of naturally fermented beer. Monika Cioch-Skoneczny et al. [19] used the non-Saccharomyces Dekkera bruxellensis 3429 to brew an IGA beer and showed that the fermentation process of the non-Saccharomyces Dekkera bruxellensis 3429 was similar to that of the US-05 yeast strain, which suggests that some non-Saccharomyces are also capable of brewing IGA beers alone.

2.3 Selection of Grape Varieties, Mode of Addition and Amount of Addition

2.3.1 Grape variety selection

Eurasian grape varieties are categorized into three main groups based on the amount of free terpene compounds present in the wine grape berries, namely muscat grape (6 mg/L), non-muscat grape (1-4 mg/L) and non-aromatic grape (less than 1 mg/L) [20]. The main aroma substances of muscat grape fruits are more than 20 terpenoids such as linalool, nerol, geraniol, citronellol, myrcene, etc, which are not only high in content but also have very low sensory thresholds [21]. The non-muscat grape type also has most of the above mentioned terpenoids, but at a lower level. The non-aromatic grape aroma substances are mainly fatty alcohols and aldehydes. The total monoterpene content of muscat grape berries is about 50 times higher than the content of non-aromatic grape berries. Therefore, it is best to choose muscat grape for IGA beers.

2.3.2 Grape must addition methods

Grape must can be optionally added to the fermentation process at different stages: boiling, whirlpool, fermentation and storage. Giovanni De Francesco et al. [16] survey of IGA commercial beers found that more than 60% of winemakers add grape must at the fermentation stage, 30% add grape must to the boiling and 10% add grape must to the whirlpool. In order to retain the primary aromatic compounds in grape must, Giovanni De Francesco et al. [16] suggested that it is best to add grape must at the fermentation stage.
2.3.3 Grape must Addition

IGA beers are beers brewed with different ratios of grape must, and their main characteristics come from primary compounds with grapes, terpene compounds, norisoprenoids compounds, methoxypyrazines and sulfur-containing compounds. The addition of grape must in IGA beer brewing is the entry of aromatic organic compounds into the beer. Too little grape must will result in insufficient grape aroma in the finished beer, while too much will result in too much grape aroma, affecting the harmonization of the finished beer.

Grapes or grape must make up between 5% and 40% of the total wort in BJCP, Antonio Castro Marin et al. [22] recommended 15% grape must, the reason for this percentage is that it works best in experimental scale trials and is the most common percentage used by producers. Gabriella Siesto et al. [23] found that the best expression of aroma was found in beers to which 15% grape must was added.

3. Perspectives

With the rapid development of the economy and the popularization and promotion of beer culture, consumers have higher and higher expectations and requirements for beer. Fruit beer is growing rapidly in the beer market, relying on its unique flavor and taste. The research and development of IGA beer meets consumers' individualized demands. At present, although IGA beer has made great progress in this field, it is still in its infancy and still has many shortcomings and vast exploration space. Research and development is still in the development phase, and there are still many different ways of treating grapes, such as hot maceration, cold maceration, carbon dioxide maceration and nitrogen maceration. Not only grape must can be used as an auxiliary ingredient, but also grape skins, pulp and pomace can be added to the beer as an auxiliary ingredient. The storage containers are not only stainless steel but also oak barrels. Different processing methods can produce different flavors of IGA beer. These are all objects that can be studied and provide theoretical support and technical reference for the development of more IGA beers.

References


