

# Progress on the brewing process of mead and its flavour components

Fangyuan Deng<sup>1,a\*</sup>, Delin Han<sup>1,b</sup>, Jianghua Zhao<sup>1,c</sup>, Huiquan liu<sup>1,d</sup>

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

<sup>a</sup> 10431221333@stu.qlu.edu.cn, <sup>b</sup> 10431221332@stu.qlu.edu.cn, <sup>c</sup> 10431221343@stu.qlu.edu.cn,

<sup>d</sup> 10431221288@stu.qlu.edu.cn

**Abstract.** Mead is a traditional fermented alcoholic beverage made from yeast fermented through a diluted honey mash. Due to the cost of production and the long lead time it takes to make it, it is generally only produced in homes or small workshops, and can be differentiated according to the degree of dilution of the honey mash and the type of fruits that are added to it during the fermentation process. Due to the richness of honey's natural substances, it has become increasingly popular in recent years, and as a result, the production of mead has increased. This review discusses the problems encountered during mead fermentation and the corresponding solutions in terms of brewing, process, and yeast selection.

**Keywords:** Mead; honey; fermentation process

## 1. Introduction

Beekeeping is an important economic activity in China, at present, China's honey production ranks first in the world, but due to the increase in production coupled with the current market honey counterfeiting is also more, resulting in a mixed scene, it is difficult to sell honey on a higher price, thus making the sales price of honey below the cost price, it is vital to look for derivatives on increasing the added value of honey. Mead is an alcoholic beverage with an alcohol content of 8-18(by volume) made by yeast fermentation through a diluted honey mash [1]. Depending on the ratio of honey to water, different types of mead can be obtained, with fermentation times ranging from a few weeks(1:3 water:honey)to a few years (1:0.5 water:honey and 1:1 water:honey). The higher the initial concentration of the honey mash, the longer the fermentation and maturation time will be, and the higher the cost required. One of the finest types of mead is 1:0.5[2]. Mead can be categorised as dry, sweet and frothy depending on the production technique. The current problems with mead fermentation are delayed and unstable fermentation and the production of unpleasant odours in the final product.

Honey contains by a variety of beneficial compounds, in the mead fermentation process most of these beneficial substances will enter the mead, mead contains a variety of nutrients needed by the body, for the body's digestion and metabolism has a very good role in the treatment of anaemia and chronic gastrointestinal disorders also has a very good role [3].

## 2. Brewing process

According to the preparation method of mead mash, mead brewing is generally classified into two types, one is hot method (the honey mash needs to be boiled before mead fermentation), and the other is cold method(no boiling is required before mead fermentation)[4]. The hot method of fermentation is characterised by a much faster rate of fermentation and clarification, and a higher degree of microbial stability[5]. However, some of the main volatile compounds are evaporated during the heating process, and some other substances are also formed, which have a great impact on the flavour substances of mead[6]. Heating creates a significant increase in furfural content, and the increase in furfural concentration does not have an effect on mead ethanol production or fermentation rate, but a furfural concentration of 2 mol/l is potent for fermentation [7]. It is widely

believed that heating will oxidise phenolic substances to reduce their antioxidant effect, but some studies have shown that heating will have some effect on mead flavour substances and will not have much effect on the antioxidant capacity of mead[8].

In order to ensure consistency in the quality of the mead product and to improve the quality of mead, there is a lot of research on this subject, for example, the use of fining agents in fermentation [9], immobilisation of cells [10], addition of nutrients to the mead mash [11], increase inoculation of yeast cells [12], and the addition of pollen to the mead mash to improve the quality of the mead, and to improve the consistency of the product [13].

### **3. Yeast selection**

The production of mead is a very time-consuming process due to the characteristics of honey such as high sugar content, low pH, low mineral content, or the presence of some other inhibitors [14] thus making the production of mead a very time-consuming process. Yeast metabolism is one of the key factors influencing the final aroma profile of fermented beverages, depending on the assimilable nitrogen content of the fermentation broth [15]. Low assimilable nitrogen content in honey will result in slow fermentation or early termination of fermentation, leading to greater variability in the quality of the final product.

In order to solve this problem, it is necessary to select a yeast that is able to tolerate high sugars and high osmotic pressure, therefore, the selection of yeast is one of the key steps in controlling the quality of mead, and the selection of yeast varies for different types of wines. The fermentation kinetics and the main volatile compounds produced as well as the organoleptic properties of the meads led to the conclusion that the *T. delbrueckii* strain is best suited for the production of sweet mead, while the *S. bayanus* strain is best suited for the production of dry mead. [16]In order to identify the most suitable yeasts for mead fermentation, a search for suitable yeasts for mead fermentation was initiated in honey. Ana Paula Pereira et al. used yeasts screened from Portuguese honey to compare the final organoleptic sensation of mead fermented with commercial winemaking yeasts, and the yeasts isolated from honey had more potential for the production of mead[17]. Meanwhile Rosario Prestianni et al. isolated *Saccharomyces cerevisiae* and *Hanseniaspora uvarum* yeast strains from honey by-products (honeycomb, capping wax, and water) and screened them for low acetic acid and hydrogen sulphide yields, high glycol content, high volatile organic compound yields, were used for mead fermentation and the final organoleptic properties and volatile compounds were measured, which ultimately led to the conclusion that brewer's yeast isolated from honey by-products and non-brewer's yeast-fermented mead proved to be a natural solution for the production of high-quality mead [18].Yeast is used in the production of mead mainly to convert the sugars in mead into ethanol, but some compounds such as higher alcohols and esters are also produced in the process. Some recent studies have used a portion of non-distilling yeast to replace yeast fermentation, which not only reduces the alcohol content of mead, but also increases some flavour substances and improves the acceptability of mead to the general consumers[19].

### **4. Influence of different production conditions on the composition of mead**

The concentration and organoleptic properties of the main volatile compounds in mead are related to the type of honey, processing technology, and choice of yeast [20]. ethanol is the most abundant volatile compound in mead, and in addition to ethanol, 3-methyl-1-butanol is the predominant alcohol.Kaylie Senn et al. studied forty-one commercial meads in the United States using a non-targeted HS-SPME-GC-MS method detected forty-three volatile compounds and concluded that acidity, sweetness, cloying and viscous mouthfeel, and alcohol heat were the most influential sensory attributes [21]. However, Teresa Gomes et al. conducted sensory analyses of two different meads, sweet and dry mead, by a panel of consumers [18] with the aim of determining the

acceptability of mead in terms of sweetness and alcohol content, and found that sweetness was the most acceptable organoleptic key attribute of mead, while alcohol content was not [22].

The choice of yeast also has a great influence on the flavour profile of mead, Joshua Johannes Van Mullem et al. selected wild type yeasts for the fermentation of mead and showed that fermentation of mead with wild yeast strains produced beverages with low to moderate ethanol content, high residual sugar content, and a high content of floral and fruity compounds. The use of mixed starting cultures of wild yeasts and non-*Saccharomyces cerevisiae* yeasts increased the complexity of the aroma profile [23].

Optimisation of process conditions also has an effect on mead composition, and the addition of hydrogels during fermentation can also have an effect on the flavour substances of mead [24], A. Roldán et al. [25] found that the addition of pollen to the mead fermentation mash increased the volatile compounds of mead, and ultimately the study showed that the highest organoleptic scores were achieved at an addition of pollen in the amount of 30 g/hl, which was the most palatable.

Different processes correspond to different varieties of mead, and the type of honey, the yeast and the source of fermentation nitrogen should be selected according to the actual production situation.

## 5. Conclusion and Perspectives

Through this thesis, the brewing process of mead as well as the content and types of flavouring substances in mead were comprehensively explored to provide corresponding references for the subsequent development of honey. Beekeeping is an important economic activity in our country, and although our country's current production of honey ranks the first in the world, there are very few studies related to honey by-products mead, for the production of mead, and for the majority of mead, the studies are only stuck in the laboratory stage. Very little research has been done on industrial fermentation of mead. It is hoped that further research on the process will enable it to be produced on a larger scale, increase the utilisation value of honey and improve the income of beekeepers.

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