

# Research overview of *Osmanthus fragrans* beer

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**Abstract.** *Osmanthus fragrans* flowers, rich in a variety of beneficial components, is a good example of homology of medicine and food. Brewing beer with *Osmanthus fragrans* is not only enjoyable but also has health benefits. The article introduces the beneficial components and aromatic substances of *Osmanthus fragrans*, discusses the *Osmanthus fragrans* beer brewing process and the characteristic flavor components, in order to provide theoretical support and technical reference for the research and development of *Osmanthus fragrans* beer.

**Keywords:** *Osmanthus fragrans*; Beneficial components; *Osmanthus fragrans* beer; Brewing process.

## 1. Introduction

Beer is the third largest drink in the world and has a wide audience. With the growing pursuit of personalization in consumer products, the use of homology of medicine and food items as auxiliary ingredients to enhance the flavor of beer has become a direction in the development of Chinese beer. In traditional Chinese medicine culture, *Osmanthus* is a good example of "homology of medicine and food" [1]. Tang *Materia Medica* records: "cure all diseases, nourish the spirit, and the color, for the medicine first employed to make, long service light body not old, the face of the light, good as a child". *Osmanthus fragrans*, also known as rock laurel, wood rhinoceros, and nine-mile fragrance, is native to southwestern China. *Osmanthus fragrans* prefers warmth and humidity, and its resistance is strong. It is widely distributed in China, of which Sichuan, Yunnan, Guangxi, and Hubei are all high-quality production areas. The fragrance of *Osmanthus* flowers is so rich that it can travel for nine miles. Combining *Osmanthus* with beer not only provides a beer rich in *Osmanthus* aroma, but also provides health benefits through the brewing process by extracting the beneficial components of *Osmanthus* into the beer, which delights the body and mind at the same time. The article introduced the beneficial components of *Osmanthus*, studied the brewing process of *Osmanthus* beer, and explored the characteristic flavor components of *Osmanthus* and *Osmanthus* beer, with a view to providing a scientific basis for the study of functional beers with flavor enhancement of medicinal herbs.

## 2. *Osmanthus fragrans* beneficial components

The medicinal value of the cinnamon tree is enormous, with its roots, stems, leaves, flowers and fruits all having medicinal value. The flowers can be harvested in the fall; the fruits in the spring; and the roots in all seasons and dried separately. Flower: Pungent, warm. Fruit: pungent, sweet, warm. Root: sweet, slightly astringent, flat. Functions and Indications: Flowers: dispersing cold and breaking knots, resolving phlegm and relieving cough. Used for toothache, coughing and phlegm, menstrual cramps and abdominal pain. Fruit: warms the stomach, calms the liver and disperses cold. For stomach pain with deficiency and cold. Root: dispels wind-dampness and disperses cold. It is used for rheumatism, musculoskeletal pain, lumbago, and toothache in kidney deficiency [2]. *Osmanthus* flavored pungent, can be used as medicine, the flowers contain a variety of biologically active ingredients, such as flavonoids, polysaccharides, soluble proteins, peptides, free amino acids, polyphenolic compounds and mineral elements. Polysaccharides, as natural organism macromolecules, have been proven to have a variety of functional activities, such as antiviral, antioxidant, anticoagulant, anticancer,



hypoglycemic and immune-enhancing. Polysaccharides in *Osmanthus fragrans* can be prepared by solvent extraction, microwave-assisted extraction and enzymatic extraction. The results showed that cinnamon polysaccharides had a certain scavenging effect on DPPH radicals and O<sub>2</sub><sup>-</sup>, and the ability to scavenge free radicals was positively correlated with the change in concentration within a certain range. Cinnamomum cassia polysaccharide has a strong promotion effect on the secretion of IL-2, IFN- $\gamma$ , and TNF- $\alpha$ , and to a certain extent, its effect is enhanced with the increase of the dose, which can be inferred that Cinnamomum cassia polysaccharide has a certain immunomodulatory effect. Cinnamon flavonoids can be extracted by ultrasonic extraction, ultrasound-assisted enzyme extraction and ultrasound-assisted bi-aqueous extraction. The effect of cinnamon flavonoids on biofilms formed by *C. albicans* at different time intervals was determined using the methyl tetrazolium salt (XTT) colorimetric method [3]. The same as when ginkgo flavonoids exert their antibacterial effects [4]. Cinnamon flavonoids induced cell membrane damage in *C. albicans*, leading to an increase in cell membrane permeability and facilitating the release of intracellular substances through the cell membrane in the form of DNA and RNA or cytoplasmic proteins. The reference protein model proposed by FAO/WHO, the total amount of essential amino acids in food should be about 40% and the ratio of E/N should be above 0.6. The total amino acid content of cinnamon ranges from 13.8% to 28.6%, of which 40% are essential amino acids [5]. Polyphenolic compounds are a class of polyhydroxy phenolic compounds widely present in plants, with good anticancer, antioxidant, anti-aging and other biological activities, the current extraction of cinnamon polyphenols with microwave extraction, ultrasonic extraction and ultrasonic-assisted extraction. The representatives of cinnamon terpenoids are the violations, which inhibit B16 melanoma cells and block melanin synthesis [6-7].

Consumer acceptance is another important factor for functional foods. Compared to jasmine and French rose, *Osmanthus* had the best organoleptic qualities, scoring highest in taste, aroma and overall acceptability. Cinnamon had the highest total phenolic content (4.33 mgGAE/g) and the highest caffeine content (4.96 mgGAE/ml). These results suggest that cinnamon can be further studied and developed into functional foods, not just as a modification [8].

**Table 1.** Beneficial components of *Osmanthus fragrans*

Compound Name	<i>Osmanthus fragrans</i> ingredients	solubility	functional role
mannitol	Glucose, fructose, rhamnose, mannose, etc.	Generally insoluble in water	Antiviral, antioxidant, anticoagulant, anticancer, hypoglycemic
flavonoid	Macrodiolide B, Kuwanon J, eupalin, etc.	Insoluble in water	Antioxidant, antibacterial, anti-inflammatory, enhancement of body immunity
polyphenol	Chlorogenic acid, caffeic acid, rosin, ferulic acid, etc.	Water-soluble	Anti-cancer, anti-oxidation, anti-aging and other biological activities
terpene (chemistry)	Linalool, $\alpha$ -violet one, $\beta$ -violet one, etc.	Insoluble in water	Inhibits B16 melanoma cells and blocks melanin synthesis

### 3. The Brewing Technology of *Osmanthus* beer

*Osmanthus fragrans* beer is made from water, malt, hops, yeast, *Osmanthus fragrans* and its extract. It is fermented through multiple processes of milling, mashing, lautering, boiling, whirling, and wort cooling. In the brewing process, the retention of the beneficial components and flavor substances of *Osmanthus fragrans* is the key to brewing.

#### 3.1. Mashing

Mashing is an important step in beer brewing and can affect the quality of the beer in a number of ways. The purpose of mashing is to convert the macromolecular nutrients in malt into small-molecule nutrients that can be absorbed and utilized by the yeast through the action of hydrolytic enzymes

under appropriate temperature and pH conditions. Whether it is the Infusion mashing or the decoction mashing, the purpose is to break down the long-chain sugars into a large number of fermentable sugars by means of enzymes under suitable conditions.

When mashing, *Osmanthus fragrans* can be pitched into the mash tun together with malt, and the polysaccharides in the *Osmanthus fragrans* may participate in the Mashing process and leach out the beneficial components. However, because the aromatic substances of *Osmanthus fragrans* are volatile, so in the subsequent wort boiling process, the wort extracted cinnamon in the aromatic substances' volatile more, so with the subsequent Lautering process to add cinnamon in general, the loss outweighs the gain.

### **3.2. lautering**

Lautering is the most decisive process in brewing process, the purpose of which is to separate the wort from the Spent grains in the Mash by means of a Sieve tray in order to obtain a clarified wort. Before the Mash is pumped into the Lauter tun, about 1cm of hot water (hot water for adjusting the amount of casting water) is set aside in the Lauter tun to support the Mash, prevent clogging of the sieve Tray, isolate the air in order to prevent the oxidation of the wort, and pre-heating of the Lauter tun. After the Mash is pumped into the Lauter tun, it is left to stand for 20 minutes to allow a stable layer of Spent grains to form, and the wort is refluxed before being Lautered. When Lautering, in order to make the contents of the Mash fully immersed in the wort, and the wort to achieve a bright and clear state, the speed of Lautering should be controlled, the first slow Lautering, to wait for the Mash to form a stable layer of spent grains gradually accelerate the speed of Lautering.

*Osmanthus fragrans* can be added to the Mash at the time of Lautering to extract the beneficial components and flavor substances, or it can be added to the Lautered wort in Wort Pre-run Buffer Tank. However, during the wort boiling process, most of the volatile components are evaporated and less *Osmanthus fragrans* and components are retained, so it is not desirable for the researchers to add it here.

### **3.3. Boiling**

Wort boiling is the most energy-consuming process in beer brewing, and the heat balance between steam consumption and secondary steam recovery in the boiling process is of great significance to beer companies in terms of energy saving and consumption reduction. Wort boiling has many effects such as wort concentration, wort sterilization and protein denaturation and flocculation, which play a key role in the flavor stability of beer [9]. Ronnie et al [10] who systematically described the main physicochemical results and energy efficiency of different boiling systems and boiling processes and wort produced by each system. Herrmann et al [11] thoroughly investigated the effect of three different boiling systems on the aging indexes of wort and beer. At the end of the wort boiling, add auxiliary substances, not only can the flavor substances and efficacy of the ingredients leached out, in the addition of high temperature can be sterilized to prevent contamination of miscellaneous bacteria.

*Osmanthus fragrans* is rich in aromatic substances, with a preponderance of volatile components. During the wort boiling process, undesirable flavors such as DMS need to be evaporated, so it is necessary to boil the wort open during the boiling process. When *Osmanthus fragrans* is added too soon, not only does it engage in a violent Meladic reaction with the wort to produce browning, *Osmanthus fragrans* volatile components such as terpenes and ketones are not retained in the beer. Therefore, *Osmanthus fragrans* should be added at the end of the boil, 5min before the end of the boil to add *Osmanthus fragrans* not only to extract flavor substances, but also to ensure the sterility of the wort through autoclaving.

### **3.4. Whirlpool**

During the process of wort being pumped into the Whirlpool in a tangential direction, the hot condensate will be gathered to the bottom under the action of centripetal force and gravity, and the clarified hot wort can be obtained after removing the sediment. The whirling should effectively separate the thermal coagulants and Spent hops in the wort, etc. If the Whirling effect is unsatisfactory, impurities such as thermal coagulants will enter the fermenter, which will affect the performance of the yeast, and thus affect the non-biological stability of the beer.

Due to its light mass and tendency to drift, *Osmanthus fragrans* cannot settle to the bottom to be discharged with the sediment. Therefore, in order to prevent floating *Osmanthus fragrans* in the wort cooling process plate heat exchanger and piping caused by clogging, it can be wrapped in gauze, etc. to hang or put into the Whirlpool. At this point, the wort temperature is greater than 85°C, and the *Osmanthus fragrans* and gauze can still be autoclaved. Since the wort temperature is lower than the boiling temperature, the process of gyratory precipitation does not need to be carried out openly, the volatilization of aroma substances is less and the impregnation time is prolonged compared with boiling, so it is inferred that the impregnation of *Osmanthus fragrans* during the process of Whirling yields more aroma substances.

### **3.5. Dry hopping of *Osmanthus fragrans***

Dry hopping is the cold extraction of non-volatile and volatile compounds from hops into beer [12]. *Osmanthus fragrans* and its extracts are also placed for maceration during beer fermentation under well sterilized and disinfected conditions. The aim is to impregnate the volatile components as much as possible into the liquor instead of volatilizing them [13]. A total of 42 volatile components were detected in unheated *Osmanthus fragrans*, and 39, 40, and 35 compounds were detected in the 80, 100°C, and 120°C treatment groups, respectively [14].

*Osmanthus fragrans* extract is made by soaking *Osmanthus fragrans* in a small amount of hot or lukewarm water for a period of time to leach out the aromatic substances and beneficial components, after which the *Osmanthus fragrans* is removed and the extract is added to the wort or liquor. It is worth noting that too much aqueous solution dilutes the wort or liquor, and a short maceration time does not fully utilize the beneficial components and aromatic substances of *Osmanthus fragrans* compared to direct maceration.

The *Osmanthus fragrans* is wrapped in gauze or other wrappings and hung in the fermenter to macerate. The wrapping is to prevent the cinnamon from drifting away and affecting the subsequent bottling of the wine. The hanging is for easy salvage of the cinnamon after emptying the fermenter and for subsequent cleaning of the fermenter. To further ensure the retention of *Osmanthus fragrans* aroma substances, the researcher recommends that this operation be carried out when preparing for pressure-hold fermentation: First dry hopping of *Osmanthus fragrans* and then seal the tank to maintain pressure. It should be noted that dry hopping of *Osmanthus fragrans* needs to open the fermenter, to do a good job of sterilization to prevent contamination by stray bacteria.

## **4. *Osmanthus* flowers components of cinnamon and *Osmanthus* beer**

*Osmanthus* flowers are fragrant and have a long-lasting scent. It has attracted many researchers to study its flavor composition and chemical composition. As early as 1955, Trico sane, p-hydroxyphenyl ethanol, D-mannitol, D-glucose, D-fructose, p-hydroxyphenyl ethanol, and succinic acid were isolated from petroleum extracts of *Osmanthus* flowers [15]. In 1978, Kaiser and Lamparsky from Switzerland identified 27 aromatic components from *Osmanthus fragrans* [16]. Cao et al [17] investigated the volatile constituents in fresh *Osmanthus* flowers using headspace solid-phase microextraction (HS-SPME) combined with gas chromatography/mass spectrometry (GC/MS) coupling technique. Twenty compounds were identified, among which  $\beta$ -linalool was the most abundant. Wu Lei et al [18] screened 14 aroma components of *Osmanthus fragrans* extract with the help of headspace solid-phase microextraction, and evaluated the contribution of the aroma

components to the aroma characteristics of *Osmanthus fragrans* extract by the numerical values of aroma activity. The results showed that linalool,  $\gamma$ -decan lactone,  $\alpha$ -violet one, dihydro- $\beta$ -violet one,  $\beta$ -violet one, and phenyl ethanol contributed more to the overall aroma characteristics of the *Osmanthus* extract, and were the important aroma components of the *Osmanthus* extract. Xin et al [19] found high content of  $\beta$ -violet one, linalool oxide (furan), trans-linalool oxide (furan) and linalool in cinnamon, which are the characteristic flavor substances of *Osmanthus fragrans*.

With the addition of *Osmanthus fragrans* at the hot end (boiling and Whirling phases), the *Osmanthus fragrans* extract was bio transformed in the presence of yeast. The major are terpenoids and ketones before and after yeast fermentation, with esters, alcohols and acetic acid present only after fermentation, while aldehydes are mostly depleted after fermentation [20]. Studies have shown that *Saccharomyces cerevisiae* is able to convert geraniol into linalool and  $\alpha$ -pinitol [21-23]. When Dry hopping of *Osmanthus fragrans*, low wort sugars plus holding pressure stresses the yeast and reduces yeast activity. It was inferred that the conversion rate of *Osmanthus fragrans* aromatic substances after impregnation into the liquor was low at this time, and the characteristics were still the characteristic flavor components of *Osmanthus fragrans*, such as  $\beta$ -violet ketone, linalool, trans-linalool oxide (furan) and  $\gamma$ -decan lactone. Therefore, the finished *Osmanthus fragrans* beer will give off the unique sweet and floral flavor.

## 5. Summary Outlook

*Osmanthus* is rich in beneficial components such as polysaccharides, flavonoids, polyphenols and terpenoids, and its flowers have an elegant, fragrant fragrance. As a good example of homology of medicine and food, *Osmanthus fragrans* beer is rich in *Osmanthus fragrans* flavor and has certain health benefits. The researcher hopes that in the subsequent *Osmanthus* beer brewing experiments, the addition of *Osmanthus* flowers in different processes can be investigated to obtain an *Osmanthus* beer rich in *Osmanthus* aroma and with Chinese *Osmanthus* characteristics, which can provide theoretical support and technical reference for the development of Chinese homology of medicine and food flavor-enhancing beers.

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