



## Cognition and Investigation on the Manufacturing of Sesame-Flavor Liquor

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### Abstract

Sesame-flavor liquor with the flavor hallmarks of thickness, purity and aromatic type and technique characteristic, is exquisite, unique in its own style, and belongs to the top grade of the liquors.

Technique outline of sesame-flavor liquor is: "steam and remain dregs, muddy bottom and brick furnace, with large bran, ferment with several microorganism, four higher, one more and one longer, blend elaborately", which highlights effects of Maillard reaction.

In the manufacturing process, we pay attention to the variety, quantity and fermentation environment of proteins and raw material ratio; Strengthen researches of effects of proteins in several amylopectin on components formation of sesame-flavor liquor; control the excessive consumption of nutrients and assure double bumpers of protein and starch fermentations; attempt to find new insights into the healthy factors of sesame-flavor liquor earlier.

**Keywords:** Sesame-flavor liquor, Maillard reaction, Process links, Cognition and investigation, Flavor and yield

### 1. Development and flavor traits of sesame-flavor liquor

Nowadays, liquors in China are classified into 11 species according to the flavor type, where there are 8 products of national standard, 1 of industry standard, 1 of the origin place standard and 1 of enterprise standard. Sesame-flavor liquor is one of the two intra-industry self-developed new liquor flavor types.

Sesame-flavor was first unconsciously found from Jingzhi white trunk by Yu Shuming, liquor-making expert in Shandong province in 1957. Sesame-flavor was first claimed by Xiong Zhishu in 1965. Sesame-flavor liquor have been investigated and developed in due form by many institutes and enterprises of provinces or industries ever since 1980s. Industry standard of "Sesame-flavor liquor" was issued in 1995, and subsequently national standard of that was published in 2006. Zhou Lixiang of Jinzhi Distillery, my collegemate, was one drafter of these two standards. Therefore, sesame-flavor liquor, as a banner of Shandong liquor, is popular over China, and deeply favored by many consumers. Meanwhile, remarkable progress was made by long-term research and remorseless efforts of Shandong liquor industry known for their representatives such as Jinzhi and Bandaojing.

Flavor hallmarks of thickness, purity and aromatic type was absorbed in the process of Sesame-flavor liquor, as well as a great deal of modern technological factors. With basic mature process, sesame-flavor liquor possesses property of purity and elegance from fen-flavor liquor, softness and fullness of highly-flavor liquor and refinement and nuance of aromatic type liquor, and also owns the compound fragrance of roasting sesame after comprehensive sensory evaluation. People feel relaxed and happy after drinking it. Sesame-flavor liquor was also advanced blending liquor of highly-flavor type.

Shandong sesame-flavor liquor was divided into three style characteristics by Huang Yeli; one is elegant type, Jinzhi Shenliang and Bandaojing sesame-flavor as representative, with higher content of ethyl acetate(160~200mg/100ml) and lower content of ethyl caproate(50~80mg/100ml), possesses the properties of serenity and elegance, purity and harmony, sesame-flavor grace; two is fragrant type, Baotu Spring sesame-flavor liquor as representative, with equivalent content of ethyl acetate and ethyl caproate(110~130mg/100ml), similar to Jiugui liquor, possesses the properties of mellow-bold and fullness, refinement and nuance and sesame-flavor; three is pit-flavor type, Shuihu 108 liquor as representative, based on traditional brewing of highly-flavor liquor, modified in the domain of material, fermentation pit and starter etc, with sesame-flavor due to long-term storage, with higher content of ethyl caproate than ethyl acetate, possessed the properties of pit-flavor and elegance, mellow-bold and fullness, typical sesame-flavor, and is popular in the southwest of Shandong province.

For owing characteristics of various traditional flavor types, fragrant but not too brilliant, sesame-flavor liquor has its own style and soon becomes fashionable all over China and top grade of liquors. Due to the elusive studies of its

fermentation mechanism and aroma components, gleaming typical sesame-flavor which was tough to control in the formation process, sesame-flavor liquor has intensively and extensively attracted many peers and experts' attention to further and elaborate investigation.

## 2. Process characteristics and links of sesame-flavor liquor

During the long period of practice, technology points of sesame-flavor liquor has been generally formed, which could be outlined as follows: "steam and remain dregs, muddy bottom and brick furnace, with large bran, ferment with several microorganism, four higher, one more and one longer(ingredient of high nitrogen, accumulation at high temperature, fermentation at high temperature, liquor flow at high temperature, more percentages of koji and long storage period), blend elaborately".

### 2.1 Basic process and fermentation vessel qualified for thickness, purity and aromatic type

Steaming is used to shiitake foodstuff without unhappy odor, remaining dregs is to inherit traditional process and beneficial to fermentation of glutinous rice and accumulation of aroma components. Referring to steaming and burning process of fen-flavor liquor, fresh sense is strengthened and quietly elegant style is highlighted.

Brick furnace is favorable to the formation of sesame-flavor with refinement and nuance, and muddy bottom can increase components of high-flavor liquor. Proper percentage of ethyl caproate plays a pivotal role in aroma releasing of sesame-flavor, and also in finesse and palatability of liquor body.

The application of muddy bottom and brick furnace is both different from the fermentations in muddy pit of highly-flavor liquor and in land cylinder of fen-flavor liquor, and similar to the fermentation in detritus or stone band pit of fen-flavor liquor. Artificial pit with muddy bottom where numerous pit mud microorganisms such as caproic acid bacteria and methane bacteria etc inhabit is beneficial to produce certain aroma constituents of ethyl caproate and caproic acid.

### 2.2 High nitrogen ingredients

Reducing sugar and amino acids as precursor matters of Maillard reaction originated from starch conversion and plant and animal protein, respectively. Certain proportion of bran and wheat is added to increase plant protein, and autolysates resulting from the death of numerous yeasts due to the accumulation process at high temperature are the source of animal protein.

Application of protein in production is closely associated with the variety, quantity, fermentation environment, pH value and utilization ratio of raw proteins. In practice, variety or ration of raw material should be paid attention to for its effects on microbial strains. Bacteria and yeast need more nitrogen nutrition while mould needs more carbonaceous nutrients. Bran contains high content of ammoniacal nitrogen, and high content of ferulic acid is transferred into phenolic compounds such as vanillin, vanillic acid, vanillic acid ester, 4-ethyl guaiacol and so on. Such variety and ratio of raw material play a vital role in regulating the propagation and metabolism of microbial strains and forming and enlarging sesame-flavor compositions.

To adjust the ratio of carbon to nitrogen and introduce microorganism qualified for glutinous rice circumstance is attempted to provide material base for Maillard reaction and produce more nitrogen compounds, especially pyrazine heterocyclic compounds.

Monomers of pyrazine compounds are mainly baking flavor, and some are popcorn flavor, similar to the so-called "scorched-scent". "Scorched-scent" is not identical to sesame-flavor unless they are in combination with furans(sweet taste), phenols(tarry), thiazole(nut scent), sulfur compounds(onion scent) in proper proportion. Accordingly, sulphur amino acids should be paid more attention excluding increasing nitrogen content of material to highlight the typical sesame-flavor, for their metabolites, sulfur compounds release aroma intensively and everlastingly, and important components of the formation of sesame-flavor. Millet contains a large quantity of sulphur amino acids such as methionine, cysteine and so on.

### 2.3 Common fermentation by various microorganisms

In combination with high temperature daqu, medium temperature starter, hanoi white qu, aroma-producing yeast and bacteria, and synergistic fermentation have gradually been the unique process characteristics of sesame-flavor liquor brewing, which is the product of combination of traditional technology and modern science.

Hanoi white qu is acid and temperature resistance and suitable at the pH values ranged from 2.5~6.5 which is quite similar to the pH scope of brewing. At such pH values, it can decompose protein into L- amino acids for direct utilization by microorganism. Excessive fermentation ascribed to the reducing sugars produced by exuberant in the process of accumulation at high temperature white qu enzyme family to a great extent, and addition amount should be adjusted.

Compound aroma-producing yeast is the second important microbial strains for sesame-flavor. Candida and Hansen

yeast are temperature resistance, and have good ability to produce esters with strong enzyme system at approximate 45°C. Liquors fermented by Hansen yeast have obvious sauce flavor, and good aftertaste; As for *Torulopsis glabrata*, strong scorched-scent; *Candida*, strong ester scent; alcohol yeast, sweet taste and little super alcohol taste; lichen yeast and *Saccharomyces italicus*, produce various kinds of organic acids, esters, alcohols and sulfur methylpropanol etc. During the period of accumulation, large quantity of yeasts propagate and die, and provide excellent protein substrates for Maillard reaction after autolysis.

Thermophilic bacilluses are the cardinal strains for sauce-flavor in the brewing of fragrant type liquor; as for sesame-flavor liquor, they do not play a cardinal role but essential. Monomer culture of these strains could usually produce sesame-flavor which is related to raw material and its protein components. We speculated that effects of proteins in several amylopectin crops on the formation of sesame-flavor should be taken further investigation.

#### *2.4 Accumulation and fermentation at high temperature*

Accumulation and fermentation at high temperature as production process of fragrant type liquor, was induced to the produce of sesame-flavor, which played a critical role in forming aroma constituents of sesame-flavor liquor, providing precursor matter and reaction environment for Maillard reaction and affording basic condition for fermentation at high temperature etc. Actually, accumulation at high temperature is the process of koji-making for the second time. As same accumulation, brewing of sesame-flavor and sauce-flavor liquors are either common or rather different in some way. As for the similar required temperature of 45~50°C, sesame-flavor liquor needs only about 10 hours while sauce-flavor 2~3 days. There are reasons that the former relies on aroma-producing yeast and hanoi white qu to grow and propagate while the latter on microorganism enriched from natural environment with the assistance of adding high temperature daqu(bacterial qu) to natural amplification culture. Consequently, resulting in different process of heating, these two manners both incubate lots of yeasts and other microorganisms, and domesticate and eliminate them.

Main flavor components of sesame-flavor liquor are nitrogen-containing pyrazine heterocyclic compounds while those of sauce-flavor liquor are oxygen-containing furans heterocyclic compounds. Due to different effects of accumulation, process conditions should be different. Generally, initial temperature is imposed as follows: about 28°C in Summer and Autumn, 30~32°C in Spring and Winter. Accumulation was less than 24 hours at 45~50°C with the height of about 50cm and the appropriate appearance of long strip. When little white strains emerged numerously in the surface layer of accumulation grains, you feel hot once you put your hands in it and bring out strong fruit aroma and accumulation could be transferred into pool. Fermentation grains of accumulation are usually covered with straw matting and Bingsi cloth in order to avoid the contamination of bacteria and keep temperature and humidity, for accumulation doesn't need to enrich exogenous bacteria from the air.

Appropriate accumulation time could avoid the excessive consumption of nutrients and assure double bumpers of protein and starch fermentations. Heating should be regulated in the scope of 10~12°C according to the rules of "first delay, then elevate and finally decline" during the period of fermentation. The top temperature and time of fermentation is approximate 40°C and 40 days, respectively.

As far as steaming is concerned, the temperature of liquor flow is very crucial and usually controlled at about 35°C in favor of the enrichment of sesame-flavor components.

#### *2.5 Layered steaming, subsection brewing and long storage according to the grades and sorts*

Due to the unique fermentation pit of sesame-flavor liquor, trace components vary in the different layers of fermentation grains. Ethyl caproate level is high in the bottom due to the effects of pit muds and thus the resultant liquor is rather dense; ethyl acetate level is high in the middle layer and thus the liquor is quite clear; ethyl lactate level is high and the liquor has strong scorched-scent. Flavor of sections in "early, middle and later stage" in each layer varies greatly, and therefore, according to flavor hallmarks of fermentation grains, steaming is undertaken according to three layers respectively. In each layer, liquor is obtained according to three periods of "early, middle and later stage". Due to the existence of high 3-methylthio-propanol level in sections of later stage, alcohol degree should be paid attention when obtaining liquor, and degree of the last section should be about 54. After over one-month storage, liquor with identical flavor was packaged with jars for long preservation. The storage vessel should be pottery jar which is beneficial to the formation of stale taste of sesame-flavor due to liquor aging. Virginal liquor should be preserved for over 3 years.

According to the production process of sesame-flavor, virginal liquor could be classified into following 5 types: 1, quite clear; 2, typical and complete; 3, rather dense; 4, with sauce-flavor; 5, special blending liquor.

In the blending process, elaborate combination and arrangement and repeated degustation are required to make perfect liquor.

### **3. Suggestions**

Sesame-flavor liquor developed late, and many issues are at the beginning stage. Therefore, we hope that many industries and enterprises could communicate and interact with one another, and we also could discuss with peers and

experts for further investigation.

3.1 Due to the large consumption of qu, complicated process, and lots of uncertain factors, sesame-flavor liquors are produced along with low yield, high cost, large labor quantity and long work hours. Considering excessive consumption of nutrients, in the premise of keeping flavor, increasing yield of liquor is a cardinal point for further investigation.

3.2 Single 3-methylthio-propanol as the standard characteristic brings controversial among many peers and experts. We think that the point is practicability, facility for detecting and perfection of detection method at present. Certainly, we should pay more attention to the investigation of other heterocyclic compounds and make sure of numerous trace characteristic components.

3.3 Since sesame-flavor liquor has countless ties with sauce-flavor liquor and is so popular with consumers, we look forward to the new insight into the healthy factors of sesame-flavor liquor imposed by peers and experts.

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