

Aroma of Sake

Chiaki Takahashi

Sake Aroma Profile



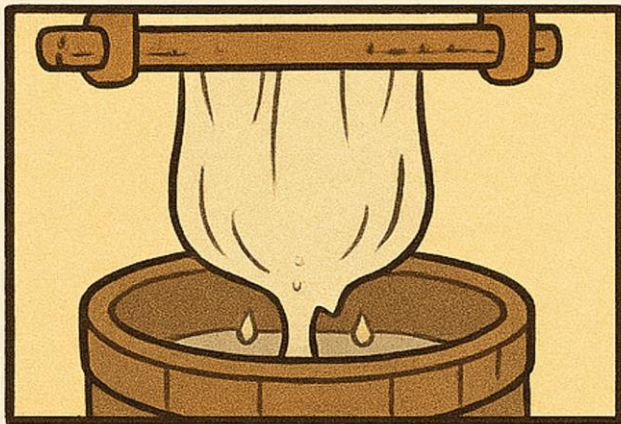
Rice washing & Steaming



Koji making



Fermentation



Pressing

Bottling & Aging



4-Vinylguaiaicol(4-VG)



Smoky, clove-like, Chinese medicine

Ferulic acid  4-Vinylguaiaicol
Ferulic acid decarboxylase

Produced by Koji-fungus, wild yeast , some other bacteria
In sake (especially sake competition) 4-VG is off-flavor
Positive contribution to the flavor of some Junmai-shu.

Mainly create during Koji-making

High temperature & high humidity

an extended koji-making process

Natural Fermentation using natural (wild)yeast

In Koji production

long koji-making process

1-octen-3-ol, which has a mushroom-like aroma

Fermentation progresses solely or the mold does not grow well...

Natto-like

(a pungent, earthy smell-some say like old gym socks)

Ethyl acetate



Naturally produced by yeast during fermentation



Type of Yeast

Fermentation Temperature

Nutrient balance in moromi

It gives a fruity and refreshing scent

Wild yeast tends to produce a large amount of Ethyl acetate
(caution:kimoto style sake making)

Isoamyl acetate



Naturally produced by yeast during fermentation

Isoamyl alcohol + Acetic acid $\xrightarrow{\text{Esterases}}$ Isoamyl acetate

Type of Yeast (No.7.9.18)

Fermentation Temperature

Amount of amino acid (protein)

It gives a fruity and refreshing, elegant scent

Unsaturated fatty acid suppress the formation of isoamyl acetate

$\longrightarrow$ highly polished rice needed

Isoamyl alcohol



Higher alcohol produced as a byproduct of fermentation, specifically when yeast metabolizes the amino acid Leucine.

It gives a slightly pungent or solvent-like smell.

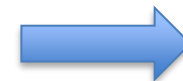
While it plays a role in the overall aroma profile, excessive amounts can give the sake a heavier and rougher impression. But it is precursor to isoamyl acetate.

Off- flavor at high concentration

low polishing ratio rice

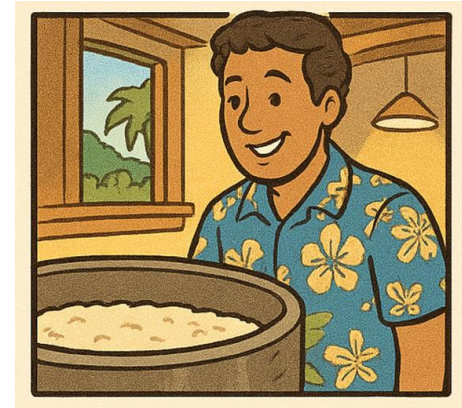
high temperature fermentation

nutrient-rich environment

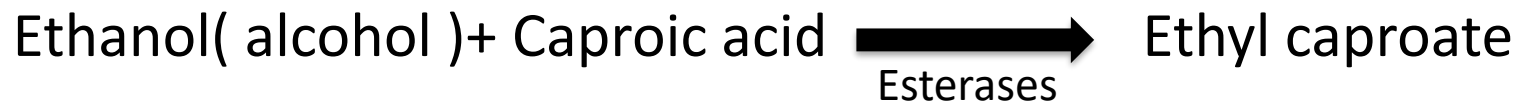


High concentration

Ethyl caproate



Naturally produced by yeast during fermentation



Type of Yeast (No.18)

Low Temperature Fermentation

Amount of caproic acid

It gives a fruity and elegant bouquet

During sake storage, ethyl caproate may hydrolyze into caproic acid, resulting in a heavier and less pleasant aroma

Caproic Acid



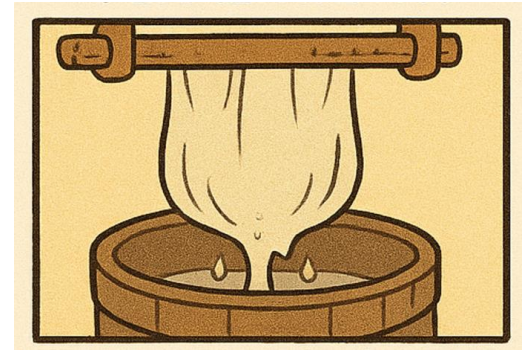
Produced by yeast during fatty acid Synthesis

It gives a heavy oily aroma

As Daiginjo sake ages, ethyl caproate may gradually hydrolyze into caproic acid, leading to a decline in its fruity aroma and the development of heavier, more animalic oily scents.

Diacetyl

Yogurt, cheese



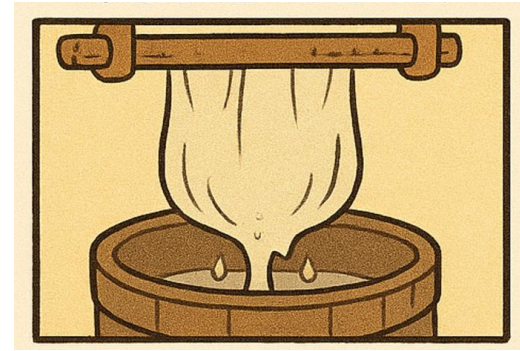
Produced during Amino acid metabolism

Diacetyl is formed as a byproduct when yeast metabolizes the amino acid valine.

During fermentation , yeast produced an intermediate compound called alfa-acetolactate and it exposed to oxygen, it oxidizes into diacetyl

If sake is pressed during the late fermentation stage while the yeast is still active and pyruvic acid level are high, Diacetyl occurs.

Acetaldehyde



Aerobic conditions- include small scale fermentation

Incomplete & Sluggish fermentation -week yeast

Nutrient Deficiency

Addition of alcohol (aru-ten)

fermentation is stopped by addition of alcohol,
pyruvic acid is converted to acetaldehyde

It adds lightness and freshness to the sake , but in
excess, it can lead to off-flavors or roughness

Mercaptan



onion

Methyl mercaptan is formed by degradation of methionine under high temperature or daylight storage of sake

Polysulfide (Dimethyl trisulfide)DMTS



Rotten cabbage

DMTS is formed by degradation of methionine and the related metabolites under high temperature storage of sake



Aging of sake-Development of Deep & sweet aroma

Typical Aroma Notes found in aged Sake;

Caramel-sotoron (sweetness)

Honey-soft sweetness and smoothness

Soy Sauce- savory,umami-rich character

Dried Fruits- Fig,prune,raisin-like depth

Brown Sugar- Warm,caramerized richness