

**THE EFFECT OF FERMENTATION TEMPERATURE AND PITCHING
RATE OF YEAST ON ESTERS CONCENTRATION IN HEINEKEN®
BEER PRODUCED BY PT MULTI BINTANG INDONESIA TBK**

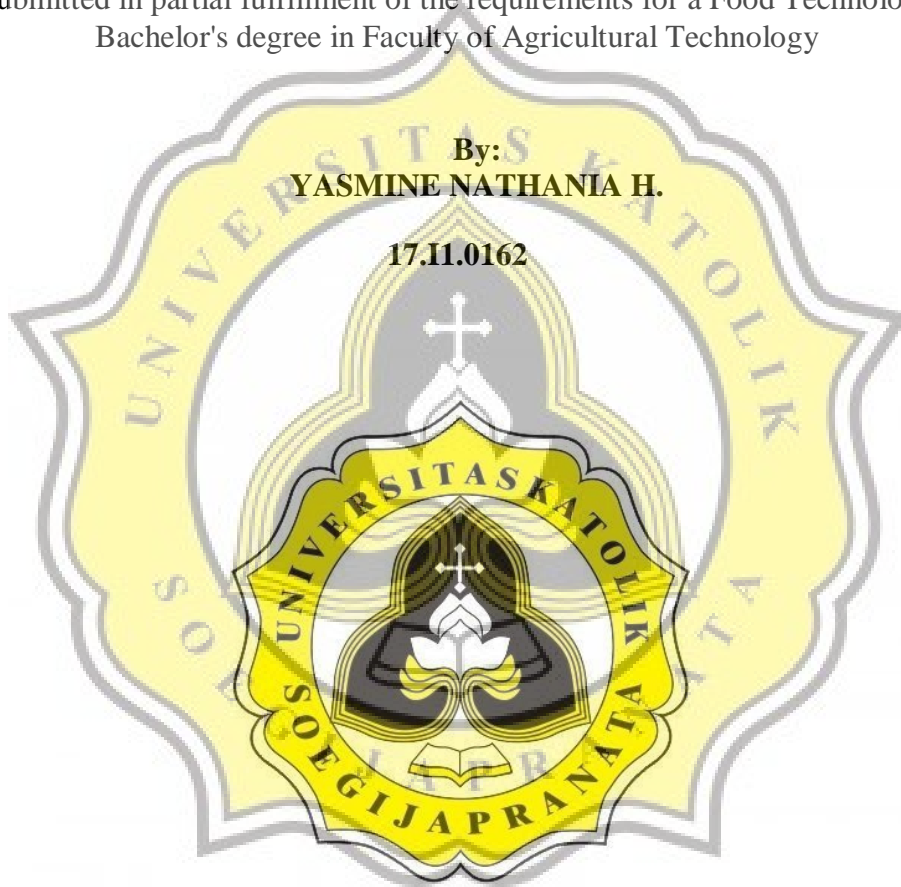
***PENGARUH SUHU FERMENTASI DAN YEAST PITCHING RATE
TERHADAP KONSENTRASI ESTER PADA BIR HEINEKEN®
PRODUKSI PT MULTI BINTANG INDONESIA TBK***

BACHELOR THESIS

Submitted in partial fulfillment of the requirements for a Food Technology
Bachelor's degree in Faculty of Agricultural Technology

By:
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SEMARANG**

2020

STATEMENT OF THESIS AUTHENTICITY

I hereby declare that the thesis entitled **"THE EFFECT OF FERMENTATION TEMPERATURE AND PITCHING RATE OF YEAST ON ESTERS CONCENTRATION IN HEINEKEN® BEER PRODUCED BY PT MULTI BINTANG INDONESIA TBK"** contains no work that ever proposed to acquire a bachelorship title in a University, and along to my knowledge, there is no work ever written or published by others, except the ones used as references in this thesis and mentioned in the list of references.

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Semarang, July 28th 2020



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HALAMAN PENGESAHAN

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SUMMARY

Beer has been one of the most popular beverages in the world. There are several qualities in beer that cannot be negotiated, and of them is its sensorial quality. Volatile flavor compounds like esters are the major deciding factor of the sensorial quality. They are produced in fermentation process by yeast. In Heineken® beer, the most prominent esters are acetate esters, especially ethyl acetate and isoamyl acetate. A well-balanced combination of the solvent-like flavor of ethyl acetate and the banana-like flavor of isoamyl acetate results in a full, balanced estery flavor that is Heineken®'s characteristic flavor. The most optimal ratio between isoamyl acetate and ethyl acetate is 1:6, with 3.75 mg/L and 22.5 mg/L being the most optimal concentration of isoamyl acetate and ethyl acetate, respectively. It is very important to control every parameter in production that will affect the final concentration of esters, especially fermentation conditions, since they are produced by yeast. This study aims to investigate the influence of fermentation temperature and yeast pitching rate on the esters concentration. The temperatures used for this study are 10, 12, and 14°C, while the yeast pitching rates are 1, 2, and 3 g/l. The concentration of ethyl acetate, isoamyl acetate, and total higher alcohol were measured using gas chromatography – mass spectrometry with flame ionization detector. All fermentations were carried for 9 days, left in 0°C waterbath overnight for deep cooling period, and analyzed for esters concentration. In this study, it was found that the concentration of esters is proportional to fermentation temperature. The highest concentration of ethyl acetate, isoamyl acetate, and total higher alcohol was found in beer fermented at 14°C. Yeast pitching rate gave no significant influence to ethyl acetate and total higher alcohol concentration. There was an increase in isoamyl acetate concentration from beer fermented with 2 g/L pitch rate to 3 g/L pitch rate. There are significant positive correlations between total higher alcohol concentration and esters' concentration. This proves a theory that higher alcohol is a substrate for esters. Temperature affects esters concentration by increasing total higher alcohol, a substrate of esters. It also affects esters concentration by increasing AATase activity, an enzyme that catalyzes esters formation, and by increasing membrane fluidity which allows more esters diffusion to fermentation medium. A higher pitching rate means more substrate used for yeast growth, thus limiting the substrate for esters formation. A further study is needed, considering that different yeast strains have different fermentation characteristics, thus different reaction to temperature and pitch rate.

RINGKASAN

Bir merupakan salah satu minuman paling populer di dunia. Bir memiliki kualitas yang harus dipenuhi, salah satunya adalah kualitas sensori. Heineken® merupakan salah satu produsen bir terbesar. Komponen-komponen flavor volatil seperti ester merupakan faktor penentu utama pada kualitas sensori. Komponen-komponen ini dihasilkan pada proses fermentasi oleh yeast. Pada bir Heineken®, senyawa ester yang paling penting dan menonjol adalah ester asetat, terutama etil asetat dan isoamil asetat. Kombinasi yang seimbang antara flavor seperti solven pada etil asetat dan flavor seperti pisang pada isoamil asetat akan menghasilkan flavor khas Heineken®, yaitu flavor estery yang penuh dan seimbang. Rasio yang optimal antara isoamil asetat dan etil asetat adalah 1:6. Konsentrasi optimal untuk isoamil asetat adalah 3.75 mg/L dan konsentrasi optimal untuk etil asetat adalah 22.5 mg/L. Kedua senyawa tersebut dihasilkan di proses fermentasi. Karena itu, sangat penting untuk mengontrol kondisi fermentasi agar diperoleh konsentrasi etil asetat dan isoamil asetat yang diinginkan. Penelitian ini bertujuan untuk membuktikan pengaruh suhu fermentasi dan yeast pitching rate terhadap konsentrasi senyawa ester dalam bir. Suhu fermentasi yang digunakan adalah 10, 12, dan 14°C, sedangkan yeast pitching rate yang digunakan adalah 1, 2, dan 3 g/l. Konsentrasi dari isoamil asetat, etil asetat, dan total higher alcohol diukur dengan menggunakan gas chromatography mass spectrometry dengan flame ionization detector. Semua fermentasi dilaksanakan dalam waktu 9 hari. Setelah 9 hari, bir yang dihasilkan didiamkan selama 12 jam dalam waterbath 0°C untuk menghentikan proses fermentasi dan mengendapkan yeast. Pada penelitian ini, dibuktikan bahwa konsentrasi etil asetat, isoamil asetat, dan total higher alcohol berbanding lurus dengan suhu fermentasi. Konsentrasi tertinggi untuk etil asetat, isoamil asetat, dan total higher alcohol diperoleh pada bir yang difermentasi pada 14°C. Yeast pitching rate tidak memberikan efek yang signifikan pada konsentrasi etil asetat dan total higher alcohol. Terdapat peningkatan konsentrasi isoamil asetat dari bir dengan pitch rate 2 dan 3 g/L. Terdapat korelasi positif yang signifikan antara total higher alcohol dengan etil asetat dan isoamil asetat. Hal ini membuktikan teori bahwa higher alcohol merupakan substrat dari senyawa ester. Suhu mempengaruhi konsentrasi senyawa ester dengan meningkatkan konsentrasi higher alcohol yang merupakan substrat senyawa ester, meningkatkan aktivitas enzim AATase yang mengkatalis formasi ester, dan meningkatkan fluiditas membran sehingga semakin banyak ester yang terdifusi ke medium fermentasi. Semakin tinggi yeast pitching rate yang digunakan, maka akan semakin banyak substrat yang digunakan untuk pertumbuhan yeast, sehingga substrat untuk pembentukan ester berkurang. Namun, masih diperlukan investigasi lebih lanjut mengingat karakteristik fermentasi yang berbeda-beda pada setiap yeast strain, sehingga menghasilkan reaksi yang berbeda-beda juga terhadap suhu dan pitch rate.

PREFACE


Praise in the name of Jesus Christ, because only by His grace and blessing, the author would have the opportunity to complete the thesis entitled “The Influence of Fermentation Temperature and Pitching Rate of Yeast on Esters Concentration in Heineken® Beer Produced by PT Multi Bintang Indonesia Tbk”. This thesis was written to fulfill the requirement to acquire Bachelor Degree of Food Technology in Soegijapranata Catholic University, Semarang, Indonesia.

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The author realizes that there were unintended errors in writing this report. The author really allows all readers to give suggestions to improve its content. However, the author hopes that this report can be an inspiration and provide useful information for others.

Semarang, July 28th 2020


Author,
Yasmine N. H

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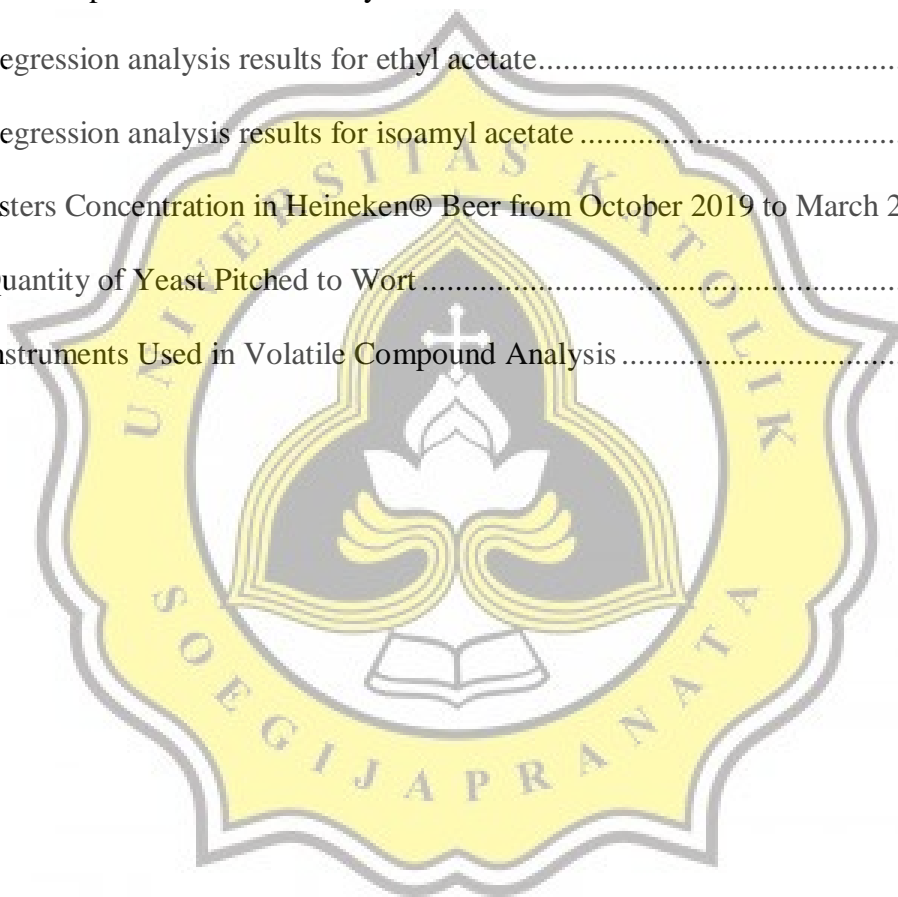
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