

7. APPENDICES

Appendix 1. Statistical Analysis of Esters Concentration

a. Normality Test

| | Tests of Normality | | | | | |
|----------------------|---------------------------------|----|-------|--------------|----|------|
| | Kolmogorov-Smirnov ^a | | | Shapiro-Wilk | | |
| | Statistic | df | Sig. | Statistic | df | Sig. |
| Ethyl_acetate | .094 | 54 | .200* | .972 | 54 | .240 |
| Isoamyl_acetate | .118 | 54 | .059 | .964 | 54 | .102 |
| Total_higher_alcohol | .141 | 54 | .009 | .959 | 54 | .059 |

b. Homogeneity Test of Temperature Treatment

| | | Test of Homogeneity of Variance | | | |
|----------------------|---------------|---------------------------------|-----|-----|------|
| | | Levene Statistic | df1 | df2 | Sig. |
| Ethyl_acetate | Based on Mean | 2.338 | 2 | 51 | .107 |
| Isoamyl_acetate | Based on Mean | 5.359 | 2 | 51 | .008 |
| Total_higher_alcohol | Based on Mean | 1.991 | 2 | 51 | .147 |

c. Homogeneity Test of Yeast Pitching Rate Treatment

| | | Test of Homogeneity of Variance | | | |
|----------------------|---------------|---------------------------------|-----|-----|------|
| | | Levene Statistic | df1 | df2 | Sig. |
| Ethyl_acetate | Based on Mean | .450 | 2 | 51 | .640 |
| Isoamyl_acetate | Based on Mean | .053 | 2 | 51 | .948 |
| Total_higher_alcohol | Based on Mean | 1.487 | 2 | 51 | .236 |

d. Independent Samples Test, testing whether there's a difference between batches or not

| | | Levene's Test for Equality of Variances | | | | | t-test for Equality of Means | | | | |
|----------------------|-----------------------------|---|------|-------|--------|-----------------|------------------------------|-----------------------|---|--------|--|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | | |
| | | | | | | | | | Lower | Upper | |
| Ethyl_acetate | Equal variances assumed | 2.242 | .140 | -.339 | 52 | .736 | -.01419 | .04183 | -.09813 | .06975 | |
| | Equal variances not assumed | | | -.339 | 49.635 | .736 | -.01419 | .04183 | -.09823 | .06984 | |
| Isoamyl_acetate | Equal variances assumed | 1.346 | .251 | -.346 | 52 | .731 | -.01903 | .05507 | -.12953 | .09148 | |
| | Equal variances not assumed | | | -.346 | 48.908 | .731 | -.01903 | .05507 | -.12970 | .09164 | |
| Total_higher_alcohol | Equal variances assumed | .103 | .749 | .671 | 52 | .505 | .01264 | .01884 | -.02517 | .05044 | |
| | Equal variances not assumed | | | .671 | 51.983 | .505 | .01264 | .01884 | -.02517 | .05044 | |

Appendix 2. ANOVA Analysis of Total Higher Alcohol

Tests of Between-Subjects Effects

Dependent Variable: Total_higher_alcohol

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|-------------------|-------------------------|----|-------------|------------|------|
| Corrected Model | .204 ^a | 8 | .025 | 24.069 | .000 |
| Intercept | 171.462 | 1 | 171.462 | 162068.614 | .000 |
| Temperature | .169 | 2 | .085 | 79.992 | .000 |
| YPR | .001 | 2 | .000 | .287 | .752 |
| Temperature * YPR | .034 | 4 | .008 | 7.998 | .000 |
| Error | .048 | 45 | .001 | | |
| Total | 171.713 | 54 | | | |
| Corrected Total | .251 | 53 | | | |

a. R Squared = .811 (Adjusted R Squared = .777)

Total_higher_alcohol

Duncan^{a,b}

| Temperature | N | Subset | | |
|-------------|----|--------|--------|--------|
| | | 1 | 2 | 3 |
| 10°C | 18 | 1.7041 | | |
| 12°C | 18 | | 1.8079 | |
| 14 °C | 18 | | | 1.8337 |
| Sig. | | 1.000 | 1.000 | 1.000 |

a. Uses Harmonic Mean Sample Size = 18.000.

b. Alpha = 0.05.

Total_higher_alcohol

Duncan^{a,b}

| YPR | N | Subset |
|-------|----|--------|
| | | 1 |
| 3 g/l | 18 | 1.7782 |
| 2 g/l | 18 | 1.7813 |
| 1 g/l | 18 | 1.7863 |
| Sig. | | .485 |

a. Uses Harmonic Mean Sample Size = 18.000.

b. Alpha = 0.05.

Appendix 3. ANOVA Analysis of Ethyl Acetate

Tests of Between-Subjects Effects

Dependent Variable: Ethyl_acetate

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|-------------------|-------------------------|----|-------------|----------|------|
| Corrected Model | .892 ^a | 8 | .112 | 14.801 | .000 |
| Intercept | 32.174 | 1 | 32.174 | 4270.296 | .000 |
| Temperature | .816 | 2 | .408 | 54.159 | .000 |
| YPR | .033 | 2 | .016 | 2.162 | .127 |
| Temperature * YPR | .043 | 4 | .011 | 1.441 | .236 |
| Error | .339 | 45 | .008 | | |
| Total | 33.405 | 54 | | | |
| Corrected Total | 1.231 | 53 | | | |

a. R Squared = .725 (Adjusted R Squared = .676)

Ethyl_acetate

Duncan^{a,b}

| Temperature | N | Subset | | |
|-------------|----|--------|-------|-------|
| | | 1 | 2 | 3 |
| 10°C | 18 | .6390 | | |
| 12°C | 18 | | .7413 | |
| 14 °C | 18 | | | .9354 |
| Sig. | | 1.000 | 1.000 | 1.000 |

a. Uses Harmonic Mean Sample Size = 18.000.

b. Alpha = 0.05.

Ethyl_acetate

Duncan^{a,b}

| YPR | N | Subset |
|-------|----|--------|
| | | 1 |
| 2 g/l | 18 | .7446 |
| 1 g/l | 18 | .7669 |
| 3 g/l | 18 | .8042 |
| Sig. | | .057 |

a. Uses Harmonic Mean Sample Size = 18.000.

b. Alpha = 0.05.

Appendix 4. ANOVA Analysis of Isoamyl Acetate

Tests of Between-Subjects Effects

Dependent Variable: Isoamyl_acetate

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|-------------------|-------------------------|----|-------------|---------|------|
| Corrected Model | 1.226 ^a | 8 | .153 | 7.604 | .000 |
| Intercept | 19.289 | 1 | 19.289 | 956.672 | .000 |
| Temperature | .896 | 2 | .448 | 22.230 | .000 |
| YPR | .112 | 2 | .056 | 2.769 | .073 |
| Temperature * YPR | .218 | 4 | .055 | 2.708 | .042 |
| Error | .907 | 45 | .020 | | |
| Total | 21.423 | 54 | | | |
| Corrected Total | 2.134 | 53 | | | |

a. R Squared = .575 (Adjusted R Squared = .499)

Isoamyl_acetate

Duncan^{a,b}

| Temperature | N | Subset | | |
|-------------|----|--------|-------|-------|
| | | 1 | 2 | 3 |
| 10°C | 18 | .4558 | | |
| 12°C | 18 | | .5696 | |
| 14 °C | 18 | | | .7676 |
| Sig. | | 1.000 | 1.000 | 1.000 |

a. Uses Harmonic Mean Sample Size = 18.000.

b. Alpha = 0.05.

Isoamyl_acetate

Duncan^{a,b}

| YPR | N | Subset | |
|-------|----|--------|-------|
| | | 1 | 2 |
| 2 g/l | 18 | .5341 | |
| 1 g/l | 18 | .6209 | .6209 |
| 3 g/l | 18 | | .6379 |
| Sig. | | .073 | .721 |

a. Uses Harmonic Mean Sample Size = 18.000.

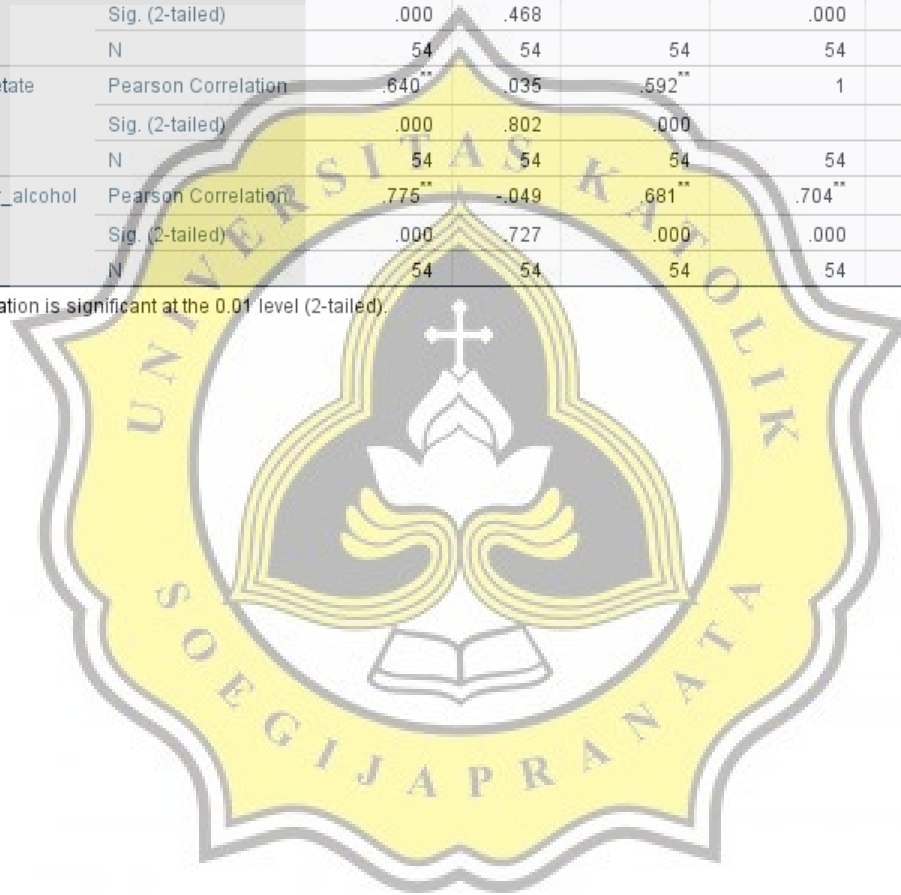
b. Alpha = 0.05.

Appendix 5. Correlation Analysis

Correlations

| | | Temperature | YPR | Ethyl_acetate | Isoamyl_acetate | Total_higher_alcohol |
|----------------------|---------------------|-------------|-------|---------------|-----------------|----------------------|
| Temperature | Pearson Correlation | 1 | .000 | .801** | .640** | .775** |
| | Sig. (2-tailed) | | 1.000 | .000 | .000 | .000 |
| | N | 54 | 54 | 54 | 54 | 54 |
| YPR | Pearson Correlation | .000 | 1 | .101 | .035 | -.049 |
| | Sig. (2-tailed) | 1.000 | | .468 | .802 | .727 |
| | N | 54 | 54 | 54 | 54 | 54 |
| Ethyl_acetate | Pearson Correlation | .801** | .101 | 1 | .592** | .681** |
| | Sig. (2-tailed) | .000 | .468 | | .000 | .000 |
| | N | 54 | 54 | 54 | 54 | 54 |
| Isoamyl_acetate | Pearson Correlation | .640** | .035 | .592** | 1 | .704** |
| | Sig. (2-tailed) | .000 | .802 | .000 | | .000 |
| | N | 54 | 54 | 54 | 54 | 54 |
| Total_higher_alcohol | Pearson Correlation | .775** | -.049 | .681** | .704** | 1 |
| | Sig. (2-tailed) | .000 | .727 | .000 | .000 | |
| | N | 54 | 54 | 54 | 54 | 54 |

** . Correlation is significant at the 0.01 level (2-tailed).



Appendix 6. Amount of Yeast Pitched

Yeast consistency was calculated with the following formula to determine the quantity of yeast to be pitched:

$$\text{Yeast consistency} = \frac{m3 - m1}{m2 - m1} = y * 100\% = y\%$$

Where:

M1 = mass of empty centrifuge bottle in g

M2 = mass of centrifuge bottle with yeast slurry before centrifuging in g

M3 = mass of centrifuge bottle with yeast slurry after centrifuging & removal of supernatant in g

Table 8. Quantity of Yeast Pitched to Wort


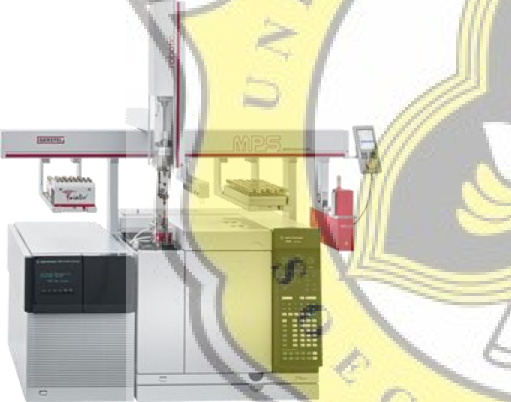
| | Batch 1 | Batch 2 |
|-------------------------|--------------------------------|----------------------------------|
| M1 (g) | 38.3 | 38.34 |
| M2 (g) | 124.46 | 110.31 |
| M3 (g) | 86.59 | 77.28 |
| Yeast Consistency | 0.55 | 0.54 |
| Yeast Quantity (g/0.6L) | 1.13 g/0.6L (pitch rate 1 g/L) | 1.13 g/0.6L (pitch rate 1 g/L) |
| | 2.26 g/0.6L (pitch rate 2 g/L) | 2.25 g/0.6L (pitch rate 2 g/L) |
| | 3.40 g/0.6L (pitch rate 3 g/L) | 3.4038 g/0.6L (pitch rate 3 g/L) |

Pitch rates used for this research were 1.00, 2.00, and 3.00 g/L. The quantity of yeast slurry to be pitched was then calculated with the following formula:

$$\text{Yeast quantity} = \frac{\text{pitch rate} * \text{volume of wort}}{\text{yeast consistency}} = \text{g of yeast}$$

Appendix 7. Instruments Used in Volatile Compound Analysis

Table 9. Instruments Used in Volatile Compound Analysis

| Picture | Note |
|--|--|
|  A photograph of an Agilent Technologies gas chromatography spectrometry instrument, model 7890B. The instrument is a large, white, rectangular unit with a control panel on the right side featuring a digital display and numerous buttons. The Agilent logo is visible on the top right of the instrument. | Agilent Technologies gas chromatography spectrometry instrument type 7890B |
|  A photograph of an Agilent Technologies gas chromatography mass spectrometry instrument, model 7890B, equipped with a Gerstel Multipurpose Sampler (MPS) for GC/MS. The MPS is a yellow and red mechanical device mounted on top of the instrument. The Agilent logo is visible on the top right of the instrument. | Agilent Technologies gas chromatography mass spectrometry instrument type 7890B attached with Gerstel Multipurpose Sampler MPS for GC/MS |

Appendix 8. Heineken® Beer Certificate of Analysis

a. October 2019



Certificate of Analysis

Quality Assurance Laboratories

Burgemeester Smeetsweg 1
2382 PH Zoeterwoude, The Netherlands
e-mail: SampleServiceCentre@Heineken.com

P.T. Multi Bintang Indonesia [TAN]

Tangerang
Indonesia

Product : Heineken lager beer
Sample code : RB-10
Sample date : 09/10/2019
Bottle date : 09/10/2019
Arrival at QAL : 28/10/2019

Submitter:

Sample quantity: 24 Bottle(s)

Our reference:



B1906018

Your reference: RB-10

| | | |
|------------------|------------|-------------|
| Q Ethylacetate | 21.8 mg/L | 20.0 – 25.0 |
| Methanol | < 5.9 mg/L | 0.00 – 6.00 |
| Ethylpropionate | 0.1 mg/L | |
| Q Propanol | 10.2 mg/L | |
| Q Isobutanol | 17.8 mg/L | |
| Q Isoamylacetate | 3.52 mg/L | 3.25 – 4.25 |

b. November 2019



Certificate of Analysis

Quality Assurance Laboratories

Burgemeester Smeetsweg 1
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P.T. Multi Bintang Indonesia [TAN]

Tangerang
Indonesia

Product : Heineken lager beer
Sample code : RB-11
Sample date : 12/11/2019
Bottle date : 12/11/2019
Arrival at QAL : 27/11/2019

Submitter:

Sample quantity: 24 Bottle(s)

Our reference:



B1906017

Your reference: RB-11

| | | |
|------------------|------------|-------------|
| Q Ethylacetate | 21.8 mg/L | 20.0 – 25.0 |
| Methanol | < 5.9 mg/L | 0.00 – 6.00 |
| Ethylpropionate | 0.1 mg/L | |
| Q Propanol | 11.2 mg/L | |
| Q Isobutanol | 17.2 mg/L | |
| Q Isoamylacetate | 3.57 mg/L | 3.25 – 4.25 |

c. December 2019



Certificate of Analysis

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P.T. Multi Bintang Indonesia [TAN]

Tangerang
Indonesia

Product : Heineken lager beer

Submitter:

Sample code : RB-12

Sample quantity: 24 Bottle(s)

Sample date : 09/12/2019

Our reference:

Bottle date : 09/12/2019

Arrival at QAL : 20/12/2019



B1906019

Your reference: RB-12

| | | |
|------------------|------------|-------------|
| Q Ethylacetate | 22.3 mg/L | 20.0 – 25.0 |
| Methanol | < 5.9 mg/L | 0.00 – 6.00 |
| Ethylpropionate | 0.1 mg/L | |
| Q Propanol | 9.2 mg/L | |
| Q Isobutanol | 17.3 mg/L | |
| Q Isoamylacetate | 3.68 mg/L | 3.25 – 4.25 |

d. January 2020



Certificate of Analysis

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P.T. Multi Bintang Indonesia [TAN]

Tangerang
Indonesia

Product : Heineken lager beer

Submitter:

Sample code : RB-01

Sample quantity: 24 Bottle(s)

Sample date : 08/01/2020

Bottle date : 08/01/2020

Arrival at QAL : 24/01/2020

Our reference:



B2000566

Your reference: RB-01

| | | |
|------------------|------------|-------------|
| Q Ethylacetate | 21.4 mg/L | 20.0 – 25.0 |
| Methanol | < 5.9 mg/L | 0.00 – 6.00 |
| Ethylpropionate | 0.1 mg/L | |
| Q Propanol | 10.8 mg/L | |
| Q Isobutanol | 15.1 mg/L | |
| Q Isoamylacetate | 3.49 mg/L | 3.25 – 4.25 |

e. February 2020



Certificate of Analysis

Quality Assurance Laboratories

Burgemeester Smeetsweg 1
2382 PH Zoeterwoude, The Netherlands
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P.T. Multi Bintang Indonesia [TAN]

Tangerang
Indonesia

Product : Heineken lager beer
Sample code : RB-02
Sample date : 10/02/2020
Bottle date : 10/02/2020
Arrival at QAL : 26/02/2020

Submitter:

Sample quantity: 24 Bottle(s)

Our reference:



B2000568

Your reference: RB-02

| | | |
|------------------|------------|-------------|
| Q Ethylacetate | 23.0 mg/L | 20.0 – 25.0 |
| Methanol | < 5.9 mg/L | 0.00 – 6.00 |
| Ethylpropionate | 0.1 mg/L | |
| Q Propanol | 11.0 mg/L | |
| Q Isobutanol | 16.6 mg/L | |
| Q Isoamylacetate | 3.81 mg/L | 3.25 – 4.25 |

f. March 2020



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P.T. Multi Bintang Indonesia [TAN]

Tangerang
Indonesia

Product : Heineken lager beer
Sample code : RB-03
Sample date : 09/03/2020
Bottle date : 09/03/2020
Arrival at QAL : 26/03/2020

Submitter:

Sample quantity: 24 Bottle(s)

Our reference:



B2000567

Your reference: RB-03

| | | |
|------------------|------------|-------------|
| Q Ethylacetate | 23.7 mg/L | 20.0 – 25.0 |
| Methanol | < 5.9 mg/L | 0.00 – 6.00 |
| Ethylpropionate | 0.1 mg/L | |
| Q Propanol | 11.3 mg/L | |
| Q Isobutanol | 15.7 mg/L | |
| Q Isoamylacetate | 3.84 mg/L | 3.25 – 4.25 |

Appendix 9. Internship Confirmation Letter from PT Multi Bintang Indonesia TBK



MULTI BINTANG

No. 4.04/HRM-TA/2019/039

Tangerang, 17 Mei 2019

Kepada Yth,
Koordinator Tugas Akhir
Unika Soegijapranata
up. Ibu Meiliana, S.GZ., M.S.
di
Tempat.

Perihal: Tugas Akhir

Sehubungan dengan Proposal Tugas Akhir di perusahaan kami PT. Multi Bintang Indonesia Tbk, Brewery Tangerang di Jl. Daan Mogot KM 19 Tangerang yang diajukan oleh mahasiswa Unika Soegijapranata atas nama:

Nama : **Yasmine Nathania Hudiono (NIM 17.11.0162)**

maka dengan ini kami sampaikan bahwa permohonan tersebut dapat kami kabulkan untuk pelaksanaan Tugas Akhir periode: **23 September 2019 – 03 January 2020.**

Kami harapkan pada Senin 23 September 2019 pukul 08.00 Wib Sdri. Yasmine tiba di Brewery Tangerang dan melapor ke Satpam dengan menunjukkan foto copy surat ini untuk selanjutnya mengikuti Safety Induction.


Fasilitas pendukung yang dapat kami berikan selama kerja praktek adalah :

1. Perlengkapan Alat Pelindung Diri (sifatnya dipinjamkan)
2. Makan siang di kantin perusahaan.

Selama menjalani Tugas Akhir, Sdri. Yasmine dibawah bimbingan dan pengawasan Human Resources Officer – bapak Sampe Sitorus (HP- 08129052462).

Demikianlah kami sampaikan, atas perhatian dan kerjasama yang baik kami haturkan terima kasih.

Hormat kami,


Andru Pribadi
Human Resources Manager

Tembusan:

- Brewing & Quality Manager

PT Multi Bintang Indonesia Tbk.
T (62-21) 2788-0800, 2910-2800 | F (62-21) 6190-190
Jl. Daan Mogot Km. 19, Tangerang 15122, Indonesia
PO Box 3264 JKT, Jakarta 10032 | multibintang.co.id

PART OF THE  HEINEKEN COMPANY



4.9% PLAGIARISM
APPROXIMATELY

Report #11066400

INTRODUCTION Research Background Beer is the oldest and most popular alcoholic beverage in the world. Across the globe, there are 28 known types of beers classified by the nature of the raw materials, microbial agents used in the fermentation steps, the location of beer production, and the overall production process ADDIN (Boulton, 2001). To simplify, beers are classified according to their fermentation temperature and yeast species used to ferment them. The most widespread type of beer is lager, which is fermented by bottom fermenting yeast *Saccharomyces pastorianus* in lower temperatures that range from 3.3 to 13.0 C. The second type is ale beers, using top fermenting *Saccharomyces cerevisiae* in higher temperatures ranging from 16 to 24 C. Lager beers are fermented for long period, usually 4-12 weeks while in contrast, ale beers are fermented in short period of time, ranging from 7-10 days ADDIN (Humia et al., 2019). One of the most well-known brewing company in the world to brew lager beer is Heineken N.V. Heineken N.V. is a Dutch brewing company which has more than 165 breweries all around the world. In 2018, Heineken beers are served across 192 countries, with the production of Heineken beer and other beer brands fully owned by Heineken N.V. reached 3.87 billion litres and 23.38 billion litres respectively ADDIN (Heineken, 2018).