

Standard Operating Procedure	
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Pale Ale Brew

UBC CHBeer Team

Brew Team

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Table of Contents

1.0 Scope and Purpose

2.0 Background

3.0 List of Ingredients

4.0 Equipment

5.0 Definitions

6.0 Responsibility

7.0 Personal Protective Equipment

8.0 Step-by-step description of the process

9.0 Safety Concerns

10.0 Emergency Procedure

11.0 REFERENCES

12.0 DOCUMENT APPROVAL SIGNATURES

1.0 SCOPE AND PURPOSE

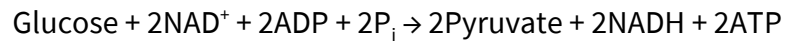
This SOP contains a list of ingredients to be used and a step-by-step description of how to perform a Pale Ale brew. It describes in detail how to perform each step and explains what happens chemically and biologically in the specific process. This ensures that the brewing process is carried out in a controlled, repeatable, and safe manner.

2.0 BACKGROUND

The chemistry behind brewing revolves around 3 main units:

- 1) Carbohydrates: Carbohydrates are mainly used in the fermentation process where the yeast metabolizes them, forming alcohol and other compounds. However, yeast can only metabolize smaller carbohydrates. These small carbohydrates are obtained after the Mashing process is performed because the heat applied in the mashing process activates the amylase enzyme which breaks down the long carbohydrate polymers into smaller monosaccharides. Amylase speeds up this process by breaking the long carbohydrate bonds using a hydrolysis reaction. These bonds are what essentially link all the monosaccharides together.
- 2) Hops: The distinct bitterness, flavour and aroma comes from the hops. More specifically, the α -acids are thought to give a pleasant bitterness while β -acids known to give an unfavourable taste. This unfavourable taste comes from a compound called iso-humulone which when exposed to light is hydrolyzed. The hydrolyzed compound can then react with Nucleophilic thiol creating 3-methyl-2-butene-1-thiol. Prevention of this reaction is possible by storing the beer in a dark environment and in brown bottles which reflect the wavelengths responsible.

- 3) Yeast: In proper conditions, yeast will consume simple sugars (Glucose) in a process known as glycolysis by cellular respiration. The Glucose will take a proton from ADP producing Pyruvate and ATP. Then fermentation occurs where the Pyruvate will decompose into Acetaldehyde and CO₂. Acetaldehyde is then reduced into ethanol.



3.0 LIST OF INGREDIENTS

- Fermentables - 6 lbs Pale Ale Malt Extract, ½ lb Carastan 35 Malt
- Hops - 1 oz Northern Brewers, 1 oz Cascade
- Yeast - 1 pack Safale US-05
- Clean water - 5 gallons
- Bag of ice - 1 bag

4.0 EQUIPMENT

- 1 7-gallon fermenter
- 1 bung (airlock stopper)
- 1 airlock
- 1 pump
- 1 cooling unit
- 3 pot
- 1 sieve
- 1 hot plate
- 1 thermometer
- 1 graduated cylinder

- 1 long stirring spoon
- 1 pipette
- 1 hydrometer
- bottles and caps
- various filling hoses

5.0 DEFINITIONS

Malt: Grains that have been soaked in water to germinate for a period of time, followed by drying with hot air to terminate the germination process.

Mash: Barley that has been heated with water signalling the activation of malt enzymes, and the conversion of starches into sugars.

Wort: The final product of mashing consisting of starches that have been broken down into sugars.

Sparge water: Hot water used to run through the grain bed in the sparging process.

6.0 RESPONSIBILITY

It is the responsibility of all members of CHBeer:

- Follow the procedures and guidelines in this Standard Operation Procedure
- Follow the Food Safe Procedure.

It is the responsibility of the lab supervisor:

- Train new laboratory operators in laboratory operation safety, experiment operation procedure and safety.

- Ensure that the Standard Operation Procedure is kept close to the operation area.
- Provide copies of Standard Operation Procedure to the operators.
- Ensure that all the regular and periodic maintenance of measuring equipment and cleaning of operation area is carried out before each brew.

It is the responsibility of the lab operator to:

- Obtain the following training course certificates from UBC RMS Course System prior to performing the described experiment:
 - Engineering Design Team Safety Orientation
 - Preventing and Addressing Workplace Bullying and Harassment
 - Chemical Safety Course
 - WHMIS Training Course

After the required training takes place, the training certificates must be recorded in the training form (Appendix A) and saved as paper copies in the laboratory.

- Read and follow all instructions in Standard Operation Procedure, and information in chemical MSDS/SDS sheets.
- Should users at any time be unsure of the safe operation of the experiment they must refer to Standard Operation Procedure for details and/or ask the laboratory supervisor for assistance.
- Maintain lab equipment and cleaning of operation area.

- Report damage to measuring equipment to the laboratory supervisor so action in terms of repair or disposal.

7.0 PERSONAL PROTECTIVE EQUIPMENT

Users should be wearing appropriate laboratory PPE, include:

- Safety goggles
- Lab coat
- Long pants
- Latex gloves

8.0 STEP-BY-STEP DESCRIPTION OF THE PROCESS

The pale ale brew process can be broken down into the following steps.

8.1. Sanitizing Equipment

8.1.1. Use 4 tsp of “Sani-Brew” to clean equipment with sponge



8.1.2. Clean hands

8.2. Milling the grains

8.2.1. In this step the grains are essentially being grinded down into smaller pieces. In this case the grains used are mostly barley. This allows for a greater surface area contact with water once the smaller pieces of the grain are in the water.

If using Malt Extract, skip this step.

8.3. Mashing

8.3.1. Heat clean water to 62.7°C - 68.3°C .

8.3.2. Add 0.5lb(226.796g) of “Carastan 35” and 0.5L of water.

8.3.2. Leave for 60min at around 65°C with lid on pot. The activation of malt enzymes and conversion of starches into sugar occurs in this process.

8.3.3. Use thermometer to take temperature every 5 minutes. Keep a graduated cylinder filled with water on the side to wash the thermometer.

8.4. Preparing Malt Extract

8.4.1. Heat 6lb(2722g) of Malt Extract (still in bucket) in warm water.

8.4.2. Leave for one hour.

8.5. Sparging the wort

The purpose of this process is to separate the liquid wort and the remaining grain.

8.5.1. Pour the wort and grain onto a colander.

8.5.2. Run sparge water through the colander with the grains in it.

8.6. Boiling the wort

8.6.1. Put the wort into boiling pot.

8.6.2. Add malt extract in boiling pot.

8.6.3. Stir until extract is dissolved.

8.5.4. Turn heat on until boiling and stir.



8.7. Adding Hops

8.7.1. Add 1 oz(28.35g) Northern Brewers for 60min of boiling.

8.7.2. Add 1 oz(28.35g) Cascade later at remaining 10min of boil.



8.8. Sanitization of brew fermenter

8.8.1. Using 6 tbs of “Sani-Brew”, clean the fermenter for 10min.

8.8.2. Rinse fermenter.

8.9. Cooling

The wort needs to be cooled down very quickly. The rapid difference in temperature will help precipitate unwanted proteins.

8.9.1. Cool the pot using an ice bath after the hop times are up.

8.9.2. Cool until 20 - 22 Celsius.

8.10. Separating the hops

8.10.1. Pour the cooled wort into a colander directly into the brewing fermenter.

8.10.2. Top up with clean water.

8.10.3. Add clean cool water directly into the wort

8.10.4. Top up until 18.9L.

8.11. Testing density

8.11.1. Pipette a desired quantity into a graduated cylinder.

8.11.2. Use hydrometer to measure the sugar level which is the potential final alcohol level.

8.12. Pitching the yeast

8.12.1. Add 1 package of “Safale US-05” to the wort in the fermenter.

8.13. Fermenting

8.13.1. Clean lid

8.13.2. Close the fermenter with lid

8.13.3. Make sure the air lock is in place.

8.13.4. Brewing Fermenter will keep the wort cool at 15 °C - 20 °C .

8.13.5. Let 1-2 week for primary and secondary fermentation to occur.

8.13.6. Ensure that the entire fermentation process has occurred.

8.14. Bottling

8.14.1. Clean bottles and bottle caps.

8.14.2. Prepare priming sugar solution by adding $\frac{3}{4}$ cups of sugar and 2 cups of water and boiling the solution. Cover pan with lid and let cool.

8.14.3. Transfer the solution into a bottling bucket.

8.14.4. Slowly siphon the fermented beer into the bottling bucket with the priming sugar making a whirlpool as the beer is poured in to ensure proper mixing.



8.14.5. Carefully transfer the beer into bottles using the faucet on the bottling bucket followed by capping the bottles with a bottle capper.

8.14.6. Let the bottles sit for 2 weeks in an 18 °C -24 °C dark room.

9.0 SAFETY CONCERNS

- This process requires high temperatures. For this reason, one must take extra care when handling the boiling pots.

- If processes are overheated, liquids may overflow the pot.

10.0 EMERGENCY PROCEDURE

In the event that an incident or accident related to laboratory work outlined here occurs:

- Stop equipment operation
- Notify others in laboratory and evacuate
- Notify the lab supervisor and emergency contacts
- Notify Safety Department of University
- Refer to hazardous agent use protocol (if necessary)

In the event of small scale and manageable chemical spills, the lab operator can perform the following procedures:

- Use protective equipment, such as gloves that can withstand the chemical, goggles or respiratory mask, boots and protective clothing.
- Liquid spills should be removed thoroughly with paper or with an absorbent, for example Vermiculite.
- Use a shovel to collect the spill. Place the paper/absorbent in a plastic container with a tight lid. Contaminated gloves and tissue can be put in the same container. Close the lid properly.
- Put a label on the container with the text: "Spill of xx" (the name of the chemical) and possibly also the text "absorbed in yy (the name of the absorbent)".
- The waste should be handled as chemical waste in accordance with the waste disposal methods in section 6.0.
- Clean the floor properly.

In the event of large scale chemical spills, the lab operator should inform the emergency contact and safety department.

Emergency Contacts	Position	Phone Number
Jonathan Verrett	Team Supervisor	604 312 4762
Joshua Donaldson	Lab Supervisor	778 321 5674
Hugo Dignoes	Safety Officer	604 339 8995
Dhanesh Kannangara	Team/Lab Supervisor	604 822 3238*
Miles Garcia	Department Safety Officer	604 822 3238*
Marlene Chow	Department Head	604 822 3238*

*General departmental phone number

11.0 REFERENCES

1. H. Association, "How to Brew Beer: Beginner - American Homebrewers Association", American Homebrewers Association, 2017. [Online]. Available: <https://www.homebrewersassociation.org/how-to-brew/beginner/how-to-make-beer/>. [Accessed: 14- Oct- 2017].
2. "Centennial Homebrewing (extract brewing)", YouTube, 2017. [Online]. Available: https://www.youtube.com/watch?v=mxdreV_tN1Y. [Accessed: 14- Oct- 2017].
3. "Welcome to How to Brew - How to Brew", Howtobrew.com, 2017. [Online]. Available: <http://howtobrew.com/>. [Accessed: 14- Oct- 2017].

12.0 DOCUMENT APPROVAL SIGNATURES

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