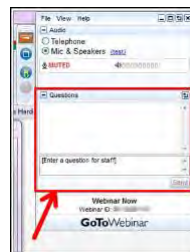
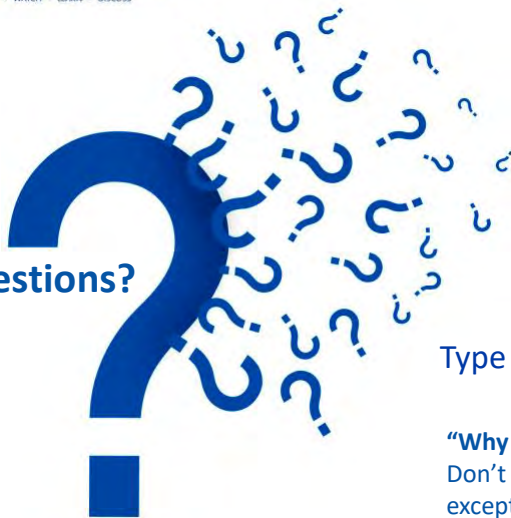




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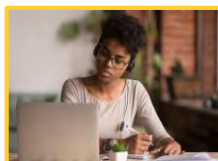
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 Ponente: Erick Carreira, ETH Zurich y JACS
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Chemists Make the Best Homebrewers



Nick Flynn
Professor of Biochemistry,
West Texas A&M University



Brian Guthrie
Corporate Research Fellow,
Cargill

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Audience Challenge Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT



What is your current level of experience with homebrewing?

- Have no experience at all
- Watched a friend brew a batch of beer
- Have brewed several batches
- Have been brewing for 2 or more years



** If your answer differs greatly from the choices above tell us in the chat!*

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CHEMISTS MAKE THE BEST HOMEBREWERS

Dr. Nick Flynn
Professor of Biochemistry, WTAMU
Councilor Panhandle Plains American Chemical Society local section
West Texas A&M Student Affiliates Advisor
Member, American Society of Brewing Chemists (ASBC)
Member, American Homebrewers Association (AHA)



TALK OUTLINE

- Methods of Homebrewing
- The Brewing Process
- Homebrew Tips for Chemists
- Brewing Concepts In Teaching





WHY HOME BREW?



- You like good beer
- It's relatively easy
- You will save money after your first batch
 - At least \$30 for store bought equivalent qty
 - At least \$60 for bar/restaurant equivalent qty

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HOW EASY IS IT?

- Do you know how to make tea?
- Are you willing to spend \$100 to save much more than that?
- Do you have two spare afternoons?



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FOUR MAJOR WAYS TO DO IT

- Extract (entry level)
- Mini (partial) mash (one additional step)
- Brew In A Bag (BIAB)
- All Grain (requires additional expense/time)



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EXTRACT BREWING

- Supplies for brew day
 - Starter kit from homebrew store (~\$80) w/ recipe
 - Large cooking spoon
 - 4 gallon cooking pot



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MINI (PARTIAL) MASH

- Extends the grain steeping step to ~45 min
- Involves rinsing the grain bag with heated water
- Generates more flavor and fermentables
- Still uses some extract to generate sufficient fermentables

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BIAB

- Good way to determine whether you want to go all grain
- Imagine mini mash on a larger scale
- You still steep the grains except now it's a much larger grain bill (8+ pounds)



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ALL GRAIN

- Requires additional equipment and expense
- Requires good temperature control and multiple temperature steps
- Not recommended for beginners
 - Reduced extraction efficiency
 - Off-flavor production
 - Expensive equipment

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STEPS (SINGLE INFUSION ALL GRAIN)

- Grain is milled
- Dough-in step where milled grain is placed in brewing water (~95 F)
- Temperature is brought up to mash temperature (~153 F) and allowed to set for 60-90 minutes
 - Activates enzyme activity
- Temperature is brought up to ~165 F for mash out
 - Increases viscosity
 - Stops enzyme activity
- Water at ~170 F is used to rinse spent grains off
- "Brewing" process is started

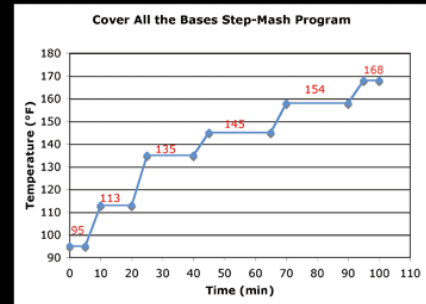
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QUICK COMMENT ON MULTISTEP ALL GRAIN

table 2

Enzyme	Optimal Temp. Range	Maximize the Enzyme	Denatures
Phytase	86-128 °F (30-53 °C)	95 °F (35 °C)	~140 °F (60 °C)
Beta-Glucanase	95-131 °F (35-55 °C)	113 °F (45 °C)	~140 °F (60 °C)
Peptidase	113-128 °F (45-53 °C)	122 °F (50 °C)	~145 °F (63 °C)
Proteinase	122-138 °F (50-59 °C)	136 °F (58 °C)	~155 °F (68 °C)
Beta-amylase	130-160 °F (54-66 °C)	148 °F (64 °C)	~160 °F (71 °C)
Alpha-amylase	150-160 °F (68-71 °C)	158 °F (70 °C)	~170 °F (77 °C)



Part of the reason why
"single step" is often used

25



DID I SAY FOUR WAYS?

- Actually there is a fifth way if you have gluten issues

Cider



- Much simpler than even extract
- Just don't use cider/apple juice that has preservatives
- Heat to required temperature (depends on source of cider/apple juice)
- Cool to pitching temperature (70 F depending on yeast)
- Pitch yeast

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THE BREWING PROCESS

- Will focus primarily on the extract / mini-mash method
- Primary difference with these and all-grain is how the fermentables are produced
 - With all-grain the brewer makes them
 - With others they are already provided by ingredients

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PREPARATION STEPS

- Clean EVERYTHING first
 - Starter Kit will come with cleaner and instructions (no-rinse cleaner is great for entry level)
- Sanitize EVERYTHING second
 - Star San (no rinse)
 - Iodophor (rinse)
 - No rinse

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BREWING



- Heat 2 gallons of water up to ~155 F
- Turn heat off
- Steep grains in grain bag for ~30 minutes (if provided)
- Treat grains like a tea bag (avoid squeezing)
- Allow water to drip back into pot

- RESULT: You have successfully extracted some flavor components as well as some fermentable sugars

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BREWING CONT'D

- Add an additional gallon of water and bring to boiling
- Optional in 2nd pot
 - Heat an additional gallon of water to ~150 F degrees and turn off heat
 - Place bottles of extract in and allow to sit for ~15 minutes
- After the original pot is boiling remove from heat
 - Add the extract bottle(s) and stir well



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BREWING CONT'D

- Bring back to a boil making sure you stir well
 - Stir well to prevent boiling over
 - Reduce the heat once boiling has occurred
- Important
 - You are stirring to prevent caramelization/scorching at the bottom of the pot
 - If you do get caramelization/scorching do NOT scrape!

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Audience Challenge Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT



What is the correct component that makes beer bitter and what process produces them?

- Hop alpha acids metabolized by yeast
- Hop iso-alpha acids metabolized yeast
- Hop alpha acids produced from boiling
- Hop iso-alpha acids produced from boiling



** If your answer differs greatly from the choices above tell us in the chat!*

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HOPS, LOVELY HOPS

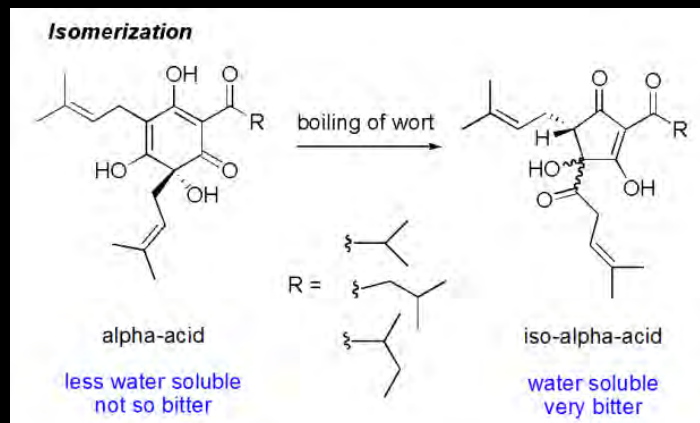


- Hops can provide three aspects of flavor to beer
 - Bittering
 - Flavoring
 - Aroma
- Timing of addition for a 60 minute boil
 - Start of boil = bittering
 - 15 minutes left = flavoring
 - 5 minutes left = aroma

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HOP ISOMERIZATION PROCESS -BITTERING-



34



OTHER ADDITIONS AT 15 MINUTES LEFT IN BOIL



- Yeast fuel (amino acids and salts)
- Irish Moss/Whirlfloc (precipitates proteins/clarifies)
- Maltodextrin (better mouthfeel)
- Other flavoring agents (spices, etc.)

35



AFTER THE BOIL



- The Wort needs to be cooled down quickly (15-25 minutes)
- Target temperature: Less than 80 degrees F
- Several methods
 - Placing the pot with a lid in an ice bath and changing ice/water out when ice melts
 - Wort chiller

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NEXT STEPS

- Place the cooled wort in your sanitized fermenter. Bring volume up to ~5.25 gallons.
- Verify the temperature is less than 80 F
 - > 80 = dead yeast, mutations and/or off flavors
- Take a hydrometer reading
- Oxygenate your wort (only time you want oxygen in your wort)

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HYDROMETERS



- Start of fermentation = verification of extent of fermentables
- End of fermentation = verification that fermentation is complete
- Based on specific gravity
- Recipe or recipe calculator will tell you target gravities
 - OG
 - FG

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PITCHING YEAST



- Important factors
 - Yeast is allowed to come to room temperature
 - Wort temperature is less than 80 F
 - OG is very close to recipe OG
- Forms of yeast
 - Liquid
 - Dry

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SEAL AND WAIT

- After pitching yeast gently stir to mix yeast and wort
- Seal fermenter with lid
 - Place airlock in lid hole and fill with liquid
 - Water
 - Vodka
 - Sanitizer (personally don't like)



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WHAT NEXT?

- Yeast should start producing CO₂ through the airlock within 1-2 days
- Suggest shaking gently after 1 day
- Call your homebrew store if this doesn't happen by 2nd day
- Wait for 1-2 weeks or transfer to secondary fermenter
 - Opinions differ regarding secondary fermenter
- Verify you are or are very close to FG- if so, then move to bottling / kegging

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Audience Challenge Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT



Why do we want to avoid washing bottles with dish detergent or no-rinse agents?

- Stops the aging process in beer
- Chemical reaction with yeast metabolites
- Effect on head retention
- None of the above



** If your answer differs greatly from the choices above tell us in the chat!*

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BOTTLING

- Clean your bottles well (dishwasher without soap is okay for new bottles but avoid no rinse addition)
- Use cleaned / sanitized racking cane and tubing from your kit
- Pro tip: Bottle on dishwasher lid for easy clean-up
- Heat up a couple of cups of water
- Add priming sugar that came with recipe kit, stir and boil for at least 1 min
- Allow to cool to 80 F



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BOTTLING CONT'D

- Sanitize bottle caps
- Use racking cane to fill bottles from fermenter
 - Avoid siphoning trub at the bottom of fermenter
 - Spring loaded tube that will provide correct headspace
- Cap bottles and wait for 3-4 weeks (yes you can sample before that but it will be flat and/or not ready for consumption)



44

Audience Challenge Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT



Which brewing method are you most interested in or would you like to know a little more about?

- Extract
- Mini-mash
- All Grain
- Brew In a Bag
- Cider



** If your answer differs greatly from the choices above tell us in the chat!*

45



HOMEBREW TIPS FOR CHEMISTS

- Focus on one or two variables at a time
- Take good notes
- Water is ~95% of beer
- Temperature, temperature, temperature
- Insanity! (with one small exception)
- Others



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FOCUS ON ONE OR TWO VARIABLES

- Good experimental protocol
- If you change too much then you don't know what made good (or bad) beer
- Variable Examples
 - Yeast
 - Water source
 - Mash temperatures
 - Method of chilling
 - Bottle size/type



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TAKE GOOD NOTES

- OG / FG
- Recipe modifications
- Hop additions (amount and time)
- Grain bill
- Time to airlock activity*
- Time to keg / bottle
- Mash pH
- Salt additions
- Water source and modification



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WATER

- Must taste good first
- Distilled / RO considerations
- Use yeast nutrients regardless

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TEMPERATURE

- Invest in a good IR thermometer
- Use a wort chiller
 - Immersion
 - Plate
 - Counterflow
- Focus on fermentation temperature first



50



INTERESTED IN MORE TEMPERATURE CONTROL?

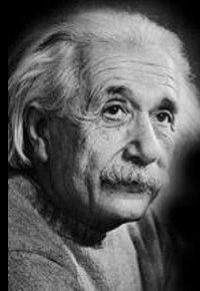
- Temperature controller with probe
- Thermowell
- Freezer or minifridge



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- One exception: Repeating a recipe will give you an idea of how good your methods currently are



"Insanity is doing the same thing over & over again & expecting different results."

Albert Einstein

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OTHER TIPS



- Use a blow off tube
- Always have an extra dry yeast packet
- Use cited sources and take forum advice with some degree of caution
- Using stove top: Foil cover your burners

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ALREADY BREWING?

- Take it to the next level
 - Professional Brewing and Fermentation Certificate
 - WT Extended Studies, Lifelong Learning Classes
 - <https://www.wtamu.edu/academics/extended-studies>
- American Society of Brewing Chemists <https://www.asbcnet.org>

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BREWING CONCEPTS YOU CAN USE IN YOUR GEN CHEM COURSES

- pH- important for enzyme activity and monitoring fermentation
- Specific heat- energy required to heat wort to boiling
- Specific gravity (density) - used to calculate ABV
- Gases- pressure, gas laws
- Henry's Law- Force carbonation charts
- Boiling point elevation
- Indicators- starch test for mashing



55



BREWING CONCEPTS YOU CAN USE IN YOUR BIOCHEM COURSES

- Glycolysis - fermentation phase
- Vitamins - cofactors for yeast enzymes
- Nitrogen metabolism
- Ions as enzyme cofactors (calcium in particular)
- Antioxidants
- Hop isomerization



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Dr. Nick Flynn
806-651-2542
nflynn@wtamu.edu

NEXT STEPS

- Contact a homebrew supply store
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CLOSING THOUGHTS

- Brewers love to share their knowledge and passion
- Good reading: The Brewer's Handbook (Ted Goldammer)
- Good Journals for Brewing: JASBC and JAFC
- Brew what tastes good to you!
- Feeling confident? Enter your beer in a competition



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