Homebrewing Recipe Development

http://destroy.net/brewing/recipedev-2015.pdf

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Porto Alegre

Introduction

- Who is this guy? Brewing Network might be the only reason why you've ever heard of me. (beersmith? btv?)
- This talk is about 1-1.5hr.
- Q & A.
- What's the point of this talk? Two things:
  1. Know your ingredients
  2. Simplify your recipe

- http://destroy.net/brewing/recipedev-2015.pdf

Know your ingredients

- Wider range of ingredients available than ever before
- Trade-offs, considerations when selecting ingredients
- I will attempt to compare equivalents
- We will look at some overlooked ingredients (don't just use what someone else does)
- Using familiar ingredients in different ways.
- Set the record straight on some new information/correcting old misinformation.

Simplify your recipe

- Most homebrewers want to write their own recipes
- Temptation is to try many new ingredients at once
- It almost never works to combine many new, unfamiliar ingredients at once, in the same recipe.
- Every ingredient should have a specific purpose
- If it doesn't, don't use it.
- The more experienced you are as a brewer, the more you can see how great a simple recipe can be.
- Challenge yourself to simplify your recipes and you might be surprised how great it can be.
- Most styles can be brewed with 2 malts & 2 hops, MAYBE up to 4, diminishing returns after 4.

Background – how did I get here?

- Simple recipe proof to myself; I didn't expect much, but this recipe was really great:
- Legacy Blonde Ale
- 1.050-1.010, 50% Pils, 50% 2-Row, 65C, 50 IBU, Citra mid-boil, Legacy late, flame-out and hop-back. WLP029 Kölsch yeast.
- No crystal malt, no dry hop, no fancy boutique yeast.
- However, a great brew of a simple recipe demands more quality of a single ingredient. You can't just jumble a bunch of different ingredients together and hope it works
- Caveat: I emphasize pale, hop-forward or yeast-forward beers & very simple lagers, less focus on porters & stouts, but these ideas can be applied there also.

Drinking break

Malt

Show of hands – Have you brewed with…

English 2-row? (Maris Otter? Golden Promise?)

German Pils? Belgian Pils?

American 2-row?

Malt

- **Malt – the ~~backbone~~ *foundation* of any beer**
- **You can make (something like) beer without hops**
- **You can make beer without (adding yeast)**
- **You cannot make beer without malt**
- **All 2-row is the same, right? Recipes simply say "5kg 2-row" – we can use any available 2-row?**
- **"Hey, I made the same recipe again and the malt flavor was different" – why? Even "2-row" can vary quite a bit.**
- **If you can choose your base malt, choose the same one from the same malter consistently that is most appropriate for your recipe.**

Malt – All American 2-row is the same?

- American 2-row – One of the most mild base malts.
- Each maltster approaches their 2-row differently. 3 common ones in American homebrew:
  - Briess (least toast intensity)
  - Great Western (medium toast intensity)
  - Rahr (highest toast intensity)
- Each of these is a little different.
- Not to mention the different varieties (Harrington, Metcalfe, etc.) from different regions (US, Canada).

Malt – Blending base malts for complexity

- Base malt character even more important in simple recipe pale beers. Example: 3 beers, 1 malt type
  - Northern German Pils – German pils malt
  - Belgian Saison – Belgian pils malt
  - Czech Pils – Moravian pils
- Best examples of a style use at least some region-specific malt, but blend for subtle complexity
- Find a blend you like. Example:
  - Saison 90% Belgian/10% German Pils
  - Czech Pils 85% Moravian Pils/15% German Pils

Blending base malt for complexity
American Pale Ale/IPA Ideas

- Goal: Bring big, aggressive (American) hop character forward without completely bulldozing the malt foundation.
- Blend lower intensity base malts instead of using higher intensity malts for subtle complexity:
  - APA 75% 2-row, 20% Maris and/or Pils, 5% dextrin malts of choice
  - IPA 85% 2-row, 13% Maris an/or Pils, 2% dextrin (Citrus Bomb)
- Instead of a small amount of a high intensity toasted malt (Munich, Vienna or Melonoidin), use a little more of a lower intensity toasted malt (Pils and/or Maris).
- Adjust lower intensity toasted malt amount based on how assertive your base malt is (Weyermann Pils vs. Castle Pils.)

Base malt - Enhance the foundation

- Adjust to enhance the base malt foundation
- Use the varying levels of toast/melanoidin content from other base malts
  - American 2-row
  - Maris Otter
  - Belgian Pilsner
  - German Pilsner
  - Munich I
  - Munich II

Least intense toast

Moderate intense toast

Most intense toast

- Small amounts of Munich I or Maris especially effective
- Helles: 98% Pilsner malt 2% Munich I
- 60/- with 4% Munich I

Malt – Crystal / Dextrin malts

- When developing a new recipe, determine mash temp first instead of using crystal/dextrin malt.
- Not all crystal malt the same. English and American crystal malts vary widely, even for same color/L.
- 70L+ Crystal malts can oxidize & spoil quickly, achieve color in other ways? Consider de-husked malts such as Weyermann carafa II/III.
- Consider how long your crystal malts have traveled, where they were stored and how long.
  - Patagonia Crystal malt from Chile?

Mashing for the most fermentable wort

- If your goal is high atttenuation (low FG). Keep it simple:
- β-amylase optimal
  - 55C (131F) @ 5.7pH, denatures ~68C (154F)
- α-amylase optimal
  - 65C (149F) @ 5.3pH.
- Enzyme reaction rates double every ~8C
- Balanced for both: how about 65C @ 5.5pH?

Malt bill – final thoughts

- Start simple – 1-2, maybe 3 malts max.
- Let your base provide the foundation: Base malt has a lot of character and complexity, become familiar with what is available to you and consistently choose what you prefer.
- Blending base malts for subtle complexity and to define toast level first before picking higher intensity malts
- Determine mouthfeel and residual sweetness using mash temp as primary method, crystal/dextrin malts secondary
- Experiment with controlling color through de-husked malts instead of higher crystal
- Simple mash parameters for fermentability: 65C @ 5.5 pH

Drinking break

Hops

A show of hands…

Have you brewed with..

Simcoe hops?

Citra hops?

Hops - still the best way to add complexity to a beer.

- Rock Star American hops
  - Amarillo, Simcoe, Citra
  - Why do these work? Any unconventional uses for these?
- Huell Program
  - Spalter Select, Taurus, Smaragd, Opal
- But, before we look at specific hops, let's cover some basics…

Hops – keeping it simple

- 1-3 hop additions in the kettle, maximum, for most styles (even APA/IPA).
- BJCP style guidelines + brewing SW can help you calculate appropriate 60min. bitterness charge.
- Middle hop addition (30-45min) increasingly considered optional, less effective.
- A single hop addition at 60-90min is sufficient for many styles where hops are not the focus:
  - Most belgian ales, many German lagers,
- APA/IPA dry hop in the 2-3oz. (60-85g) range for 5-7 days is a good goal/target to start with.

Spotlight on American hype hops..

- You know which ones I'm talking about…
- If you want to make new-school killer hoppy beer, you really only need 1-2 of these high impact hops.
- So, what makes them so great?
- And if you already have them in the brew house, are they only good for late-hop/dry hopping, or can we use them elsewhere?

Essential oils – hundreds or thousands?

- ~.5-3.5+% volume by weight. Extremely volatile.
- 80% hydrocarbons. Primarily: (1,4)
  - Humulene: Woody, balsamic.
  - Carophyllene: Black-pepper spicy.
  - Myrcene: Geranium-like floral.
  - Farnesene: Gardenia-like floral. (less frequent)

  Sometimes:
  - Linalool: Citrus-like bergamot. (least frequent, but high impact)
  - Beta-Pinene: Spicy, piney
  - Geraniol: Floral, rose
  - Limonene: Citrus, fruity
- 4MMP (4-mercapto-4-methylpentan-2-one) Muscat grape/black currant. Occurs naturally in grapes, wine, green tea grapefruit juice. Signature character of New World Hops. Highest levels in Summit, Simcoe, Topaz. (5)
- Monoterpenoids, Sesquiterpenoids.. We know less about hop oils than we think we do.

Amarillo

- VGXP01 cv. - daughter of ?? And ??.

Alpha	Beta	Cohumulone	Total Oils	Myrcene	Caryophyllene	Humulene	Farnesene
8-11%	6-7%	21-24%	1.5-1.9%	68-70%	2-4%	9-11%	2-4%

- First discovered in 1990 in a hop field newly planted with Liberty. Unlike Liberty, it contained the essential oil farnesene *(Gardenia-like)*
- The physical and chemical characteristics of the new variety determined to be unlike those of any other. Patent filed 2/3/2000
- Description: Floral and citrus (lemon, orange and grapefruit)
- A new variation of this idea of a unique signature Hop; a half-step beyond Cascade, Centennial, Chinook.
- Any unconventional uses? Best used for dry/late hopping.. Anything else might be a waste.

Simcoe

- YCR-014 - daughter of ?? And ?? (proprietary breeding)

Alpha	Beta	Cohumulone	Total Oils	Myrcene	Caryophyllene	Humulene	Farnesene
12-14%	4-5%	15-20%	2.0-2.5%	60-65%	5-8%	10-15%	0%

- β-pinene 0.185%, linalool: 0.427%, Geraniol .82%
- Patent filed 4/6/1999
- Commercial Description: versatility and unique characteristics; several different aromas: passion fruit, pine, earthy, and citrus.
- Single variety, big complexity. One-stop signature hop that is a full step beyond classic "C hops", Cascade, Centennial, Chinook.
- It has become the IPA/APA expected signature hop
- American brewing would not be the same without this hop
- Low cohumulone! Great for bittering almost anything.

Citra

- HBC 394 bred in the early 90s, not released until 2008.
- Crosses: 50% Hallertau, 25% U.S. Tett**, 19% Brewer's Gold, 3% EKG, 3% unknown. *"US Tett" = WTF is that? (probably actually U.S. Fuggle)*

Alpha	Beta	Cohumulone	Total Oils	Myrcene	Caryophyllene	Humulene	Farnesene
11-13%	3.5-4.5%	22-24%	2.2-2.8%	60-65%	6-8%	11-13%	<1.0%

- β-pinene .93%, Linalool .70%, Geraniol .48%,
- Patent filed 1/23/2009
- Almost 3% oil. Citra is the absolute rock-star darling hop of the craft beer world right now. New school signature hop.
- One-stop signature hop that is 2 steps beyond beyond classic "C hops", Cascade, Centennial, Chinook.
- I like it more on the hot side than in dry hop. Citrus Bomb

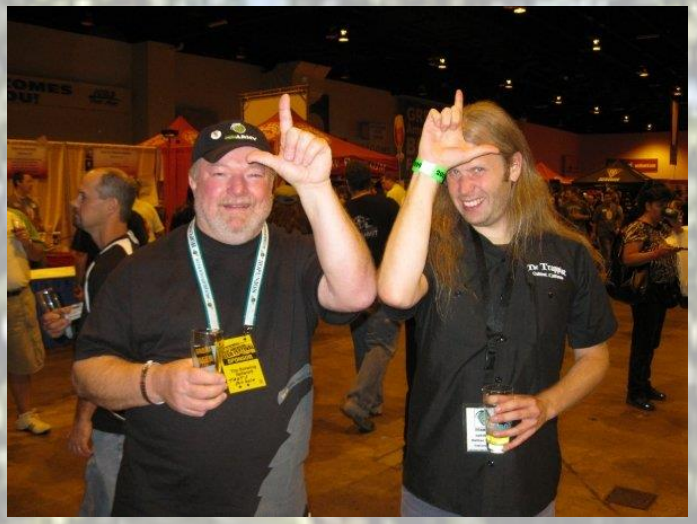
Fun with Simcoe, Amarillo, Citra…

Fun with Simcoe, Amarillo, Citra…

Citrus Bomb in Porto Alegre

- Northern California style Double IPA
- Collaboration w/ Tupiniquim
- Simcoe, Citra, Amarillo, Equinox (I'll talk more about Equinox tomorrow)
- Target OG/FG: 1.072-1.012
- ~80 IBU
- 8% ABV

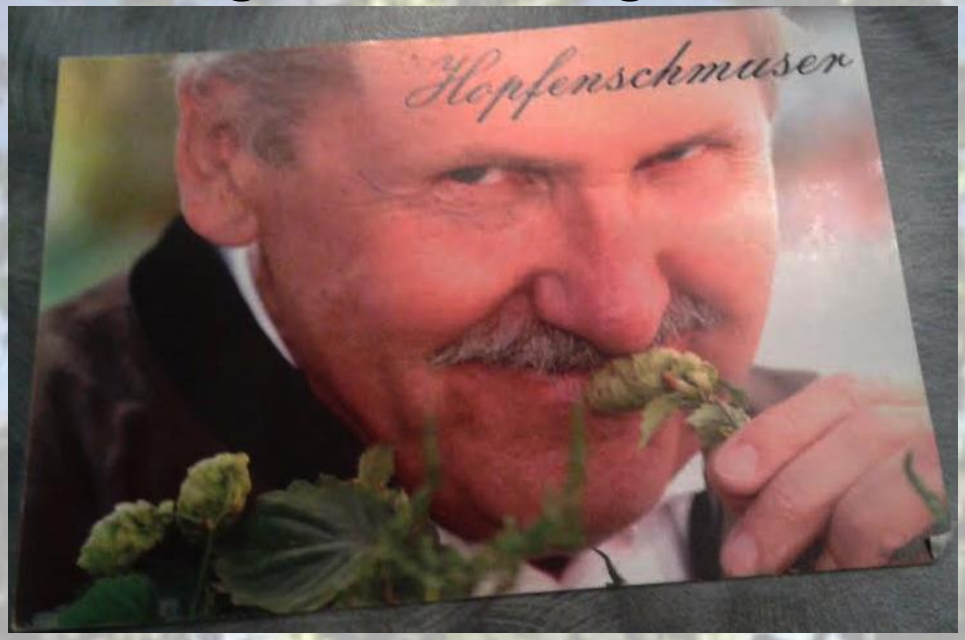
What collaboration brewing is really like…



To contrast these high-impact American hops..

Spotlight on newer German hops..

- Germans love their classic noble varieties. Keeping them alive and thriving has been tough, thanks to Hüll (Huell)



- The Hop Cuddler. This man really loves his hops!
- Let's look at some German Noble variants that are different than the rock star American Hops that we just looked at.

German Spalter Select, or just "Select"

- Daughter of 76/18/80 and 71/16/7. released in 1993 (or 2001?)

Alpha	Beta	Cohumulone	Total Oils	Myrcene	Caryophyllene	Humulene	Farnesene
4.1-5.1%	3.9%	22-23%	0.5-0.9%	19.0%	9.8%	19.8%	19.5%

- New world monoterpinoids: Linalool: 1-1.5%
- Old world sesquiterpinoids: Beta-Caryophyllene: 0.37-0.4%, Farnesene: 14.5-22.0% (Gardenia-like floral, less common hop oil)
- 3X+ myrcene compared to classic Spalt. Not as much as aggressive American hops.
- Spalt one of the more expressive of the classic German nobles, Select could provide even more hop expression into a old world beer with late kettle hopping. Kolsch? Maibock? Alt?

German Hallertauer Taurus

- Daughter of 82/39/37 and 85/54/15M. released in 1995

Alpha	Beta	Cohumulone	Total Oils	Myrcene	Caryophyllene	Humulene	Farnesene
12-17%	4.0-6.0%	20-25%	0.9-1.4%	30-50%	6-11%	23-33%	1<%

- New world monoterpinoids: Linalool: 1-1.5%
- Old world sesquiterpinoids: Beta-Caryophyllene: 0.3-0.31% Farnesene: <1
- Xanholhumol: .9-1 (largest of any hop?)
- Aroma specification: Lime, Currant, Spicy, Pepper.
- Oil profile closer to newer super high alphas such as Herkules (menthol) vs. other classic Nobles.
- Brewing ideas: A beer w/ some ester content, to work with fruity, citrus qualities. Alt/Koelsch yeast or Belgian/French Saison yeast.
- Consider trying it in a beer such as this Session Saison

German Opal

- Huell, Registered in 2001 and marketed since 2004

Alpha	Beta	Cohumulone	Total Oils	Myrcene	Caryophyllene	Humulene	Farnesene
5-8%	3.5-5-5%	13-17%	.8-1.3%	20-45%	8-15%	30-50%	1<%

- New world monoterpinouds: Linalool: 1-1.5%
- Old world sesquiterpinoids: Beta-Caryophyllene: 0.3-0.39% Farnesene: <1
- The lowest co-humulone of the Huell hops presented here. (also lowest acreage)
- High humulene content. (humulene = woody, balsamic)
- Aroma: Spicy, Pepper, Grass, Anise, slight fruit/citrus.
- Brewing ideas: Ideal for bittering?

German Smaragd ("Emerald")

- Daughter of Hallertau Gold

Alpha	Beta	Cohumulone	Total Oils	Myrcene	Caryophyllene	Humulene	Farnesene
4.0-4.6%	3.5-5.5%	13-18%	.4-0.8%	20-40%	9-14%	30-50%	1<%

- New world monoterpinouds: Linalool: 0.8-1.4%
- Old world sesquiterpinoids: Beta-Caryophyllene: 0.3-0.33 Farnesene: <1
- Released in 2007; low acreage as of 2013; grown in the Hallertau region
- Expressive hop with nearly 1:1 alpha:beta
- High humulene content. (humulene = woody, balsamic)
- Aromas: subtle thyme, tarragon, clove, anise, clove and tobacco.
- At 13-18% cohumulone and slightly lower myrcene on than Opal.
- Loose Change 60/-, or maybe a Schwarzbier

Hops: Compare & Contrast

Hop	Alpha	Beta	Coh.	Total Oils	Myrcene	Caryophyllene	Humulene	Farnesene	Linalool
Amarillo	8-11%	6-7%	21-24%	1.5-1.9%	68-70%	2-4%	9-11%	2-4%	?
Simcoe	12-14%	4-5%	15-20%	2.0-2.5%	60-65%	5-8%	10-15%	0.0%	0.4%
Citra	11-13%	3.5-4.5%	22-24%	2.2-2.8%	60-65%	6-8%	11-13%	<1.0%	0.7%
Select	4.1-5.1%	3.9%	22-23%	0.5-0.9%	19.0%	9.8%	19.8%	19.5%	1.0%
Taurus	12-17%	4.0-6.0%	20-25%	0.9-1.4%	30-50%	6-11%	23-33%	1<%	1.0%
Opal	5-8%	3.5-5.5%	13-17%	.8-1.3%	20-45%	8-15%	30-50%	1<%	1.0%
Smaragd	4.0-4.6%	3.5-5.5%	13-18%	.4-0.8%	20-40%	9-14%	30-50%	1<%	0.8%

- Myrcene: Petroleum, spicy, geranium-like floral. (most common oil)
- Carophyllene: Black-pepper spicy.
- Humulene: Woody, earthy balsamic.
- Fasnesene: Gardenia-like floral. (less frequent)
- Linalool: Citrus-like bergamot. (least frequent, high impact)

American IPA Hops: How much in late/dry hop? (Nathan, don't make it so complicated, please)

Beer	ABV	Late kettle	Late kettle varieties	Dry total	Dry varieties	Dry contact time
Pliny	8.1%	3.5 oz / 100g	28g Centennial, 2.50oz/71g Simcoe	3.75oz/ 106g	CTZ, Centennial Simcoe	75% 12-14 days, 25% 5 days
Union Jack	7.5%	3.5 oz / 100g	Centennial, Cascade	6oz/ 170g	2.5oz/71g Cascade & Centennial; .5oz/14g Simcoe & Amarillo	50% days, 50% 3 days
Sculpin	7.0%	1oz/28g	Amarillo	3oz/ 85g	1 oz/28g Simcoe, 2oz/57g Amarillo	7 days
Racer 5	7.0%	1oz/28g	CTZ, Cascade	1.5oz/ 42g	Amarillo, CTZ, Centennial	2 weeks?
Maharaja	10.5%	1oz/28g	Centennial, Simcoe	9oz/ 255g	4.5oz/128g Simcoe, 2.25oz/64g Centennial, Chinook	2 weeks?
West Coast	7.3%	1oz/28g	CTZ, Simcoe	2oz/ 57g	Amarillo, Centennial, CTZ, Simcoe	2 weeks?
IPAX	6.7%	2oz/57.g	CTZ, Simcoe	2.6oz/ 74g	CTZ, Simcoe	10 days

- All Quantities assume 20 liter batch size

Drinking break

Yeast

A show of hands:

- **Have you brewed with White Labs yeast?**
- **Wyeast?**
- **Bio4 yeast?**
- **Do you guys brew lagers?**
- **Do you experiment with Brett and sour beers?**

Yeast

- Equal but different! 1st rule should be to use the freshest option available to you
- 001/1056 (Bio4 SY025?)
- 590/3711/T-58 (Bio4 SY064?)
- 004/1084/S-04 (SY032?)
- 830/2206/S-23 (Bio4 SY004?)
- Brett Mythbusters

- Warning: Unscientific data incoming!

Yeast – 001/1056/US-05/Bio4 SY025
Clean and dry ferment is the goal

American Ale Yeast	Attenuation	Flocculation	Temp range	Alcohol Tolerance
WLP001	73-80%	Medium	68-73F (20-23C)	High
WY1056	73-77%	Medium-Low	60-72F, (15-22C)	11% ABV
US-05	??-81%	Medium	59-71.6F (15-22C)	??
SY025	73-77%	Medium	60-72F, (15-22C)	11% ABV

- **1056 – Unhappy? Higher chance for green apple/solvent.**
  - **Can perform well low as 59-64F. Almost like Koelsch.**
  - **Recommendation: Pitch at 63F raise to 67F ~7 days**
  - **Risks: Fusels, higher alcohols and acetaldehyde.**
- **001 – Unhappy? Higher chance for butter.**
  - **Prefers temp: 20C-21C (68-70F) (faster, warmer ferment than 1056)**
  - **Recommendation: Pitch 20C (68F) raise to 21C (70F) for ~6 days**
  - **Risks if mistreated: Diacetyl. Higher sensitivity to temp range fluctuation than 1056 (too hot or too cold)**

001/1056 Experiment – what does it tell me?

- Learn how the ingredients respond to your process and your brewing technique, and let that guide your ingredient choices.
- On my system, with my process they are different yeasts, I may or may not want to select them equally.
- If I have better temp control for a batch, maybe 001 is a better choice, or, if not, 1056 might be a better choice

Yeast – 004/1084/S-04/SY032 – Irish Ale

Goals: Low yeast character compared to English, higher flocculation vs. 001, Better attenuation higher ABV tolerance than most English strains

Irish Ale Yeast	Attenuation	Flocculation	Temp range	Alcohol Tolerance
WLP004	69-74%	Medium-High	65-68F (18-20C)	Medium-High
WY1084	71-75%	Medium	62-72F (16-22C)	12% ABV
S-04	??-75%	High	59-68F (15-20C)	??
SY032	68-73%	Medium	64-72F (18-22C)	12% ABV

- **004: Optimum temp: 65-68F , Attenuation: 69-74%**
  - **Try this with Southern Hemisphere & new school tropical/berry/melon hops**
- **1084: Optimum temp: 62-72F, Attenuation: 71-75%**
  - **Watch out for Diacetyl precursor with both**
  - **"What happened?! My beer was fine a week ago?"**

Saison Yeast

Saison Yeast	Attenuation	Flocculation	Temp range	Alcohol Tolerance
WLP590	73-80%	Medium	69–75F (20–24C)	5-10%
WY3711	77-83%	Low	65-77F (18-25C)	12% ABV
T-58	??-70%	Low	59-68F (15-20C)	??
SY064	70-78%	Medium-High	68-78F (20-26C)	12% ABV

- **Higher than average O2 required**
- **Likes to be repitched – work with it.**
- **Needs time to finish out.**

Yeast – 830/2206 - Weihenstephan 206

Goals: Clean, predictable performance on the homebrew scale

Lager Yeast	Attenuation	Flocculation	Temp range	Alcohol Tolerance
WLP830	**74-79%**	Medium	50-55F (10-13C)	Medium
W2206	73-77%	Medium-High	**46**-58F (8-14C)	9% ABV
S-23	??-**82%**	High	53.6-59F (12-15C)	??
SY004	72-77%	Medium	48-59F (9-15C)	9% ABV

- **Poor 2206 never got a fair shake in my setup.**
- **Always found 830 to perform more predictably in attenuation and flocculation**
- **I have very soft water, maybe different Ca required?**
- **Footnote: some would say 830 == 2124 (old info)**

Brettanomyces mythbusters
Brett species, strains, confusing terminology

- **(Intentional) use in the brewing industry includes two species of Brettanomyces available from yeast companies:**
  - **Bruxellensis (the majority of the strains)**
  - **Anomalus**

Brettanomyces mythbusters
Brett species, strains, confusing terminology

- Diff brett strains = varying levels of ability to ferment maltose
- This should sound familiar: ale (cervisea) and lager (pastorianous) species & maltotriose fermentability
- Some newly available Brett strains offered may not be as aggressive as classic Brux & Lambicus. Recent isolation work seems to be bringing us more subtle, mellow brett strains.
- Remember: brett is certainly an acid producing microorganism but Brett does not always equal SOUR!

  (We have lacto and pedio to help with that)

Brettanomyces mythbusters
4 species of Brett

- ***I got this info wrong on a 2009 BN show, so let me set the record straight***

1. **Anomalus**
   - Clausenii is a strain (isolated N. Hjelte Claussen) WLP645
2. **Bruxellensis WLP650, WY5112**
   - Lambicus is a strain WLP653, WY5526
   - Drie is a strain

Brettanomyces mythbusters
4 species of Brett

3. **Custersianus**
   - No commonly available commercial strains.
4. **Naardenensis**
   - No commonly available commercial strains.. Yet

- **Honorable mention - Nanus**
  - Nanus reclassified as Eeniella nana, genetically a close relative of Brettanomyces.

Drinking break

Let's summarize all of this
Simplifying your recipe

Example A: BDS 2008 (before)

- 78% Pils
- 10% Sugar
- 5% Caramunich
- 2% Aromatic
- 2% Biscuit
- 2% Special B
- 1% Chocolate
- Fuggle, Mt. Hood, Styrian
- WLP530
- 1.100-1.017 11% ABV 25 IBU
- MEH! Too complicated!

Example A: BDS 2010 (After)

- 80% Belgian Pils
- 10% Munich
- 10% D2
- Northern Brewer, Styrian Goldings
- WLP530
- 1.090-1.010 28 IBU 10.6%ABV
- Nice and dry, big complexity.
- Much better beer, much better showing in competition.
- OK, I’m trying to learn my lesson here…

Conclusion

- Look beyond what everyone else is doing and create your own story.
- There's more money In craft beer than ever before, that means more R&D ideas and more raw materials for us in homebrewing also.
- Develop your own recipes based on all of these new ideas, techniques and ingredients that are available (but don't forget to involve others' whose palates you trust!).
- Start simple and don't make it overly complicated where you don't need to. Brewing has enough variables you can't control, simplify the ones that you can.

Questions?

- Contact
  - nathan@thebrewingnetwork.com
  - Twitter: @nathanhomebrew
- Links
  - http://destroy.net/brewing
- Special thanks to:

TUPINIQUIM
Cerveja Artesanal Brasileira

BeerSmith 2


Backup

Essential oils – hundreds or thousands?

- ~.5-3.5+% volume by weight.
- Extremely volatile.
- 80% hydrocarbons. Primarily: (1,4)
  - Humulene: Woody, earthy balsamic.
  - Carophyllene: Black-pepper spicy.
  - Myrcene: Geranium-like floral. (most common oil)
  - Farnesene: Gardenia-like floral. (less frequent)

Essential oils – hundreds or thousands?

Sometimes:

- Linalool: Citrus-like bergamot. (least frequent, high impact)
- Beta-Pinene: Spicy, piney
- Geraniol: Floral, rose
- Limonene: Citrus, fruity

- 4MMP (4-mercapto-4-methylpentan-2-one) Muscat grape/black currant. Occurs naturally in grapes, wine, green tea grapefruit juice. Signature character of New World Hops. Highest levels in Summit, Simcoe, Topaz. (5)
- Monoterpenoids, Sesquiterpenoids.. We know less about hop oils than we think we do.

Essential oils – by group

- **Monoterpenoids (associated with fresh dry hop aroma)** (2)
  - **Myrcene: spicy, petroleum**
  - **Linalool: floral, citrus**
  - **Geraniol: floral, rose**
  - **Limonene: citrus, fruity**
  - **Terpineol: woody, resinous**
  - **Nerolidol: rose, apple, woody**
  - **Beta-Pinene: spicy, piney**
  - **Cirtral: citrus, lemon**
  - **Cadinene: citrus**
- **Sesquiterpenoids (Associated with noble hop aroma), woody, resin-like.** (2)
  - **Alpha-Humulene**
  - **Beta-Caryophyllene**
  - **Beta-Farnesene**
  - **Humulene Epoxide**
- **Understanding of hop oils is in its infancy.**

Yeast - 3711

- 3711 – A special strain for Saison type yeast character. There is no equivalent elsewhere.
- Optimum temp: 65-77F
- Attenuation: 77-83%
- Slightly less complex than 565/3724
- More dependable attenuation performance
- Absolutely glorious with noble hops and pils malt.. Or slightly more characterful hops.

Speaking of clean and dry - WLP029

- WLP029 is a special strain for clean and dry brewing, there is no equivalent.
- Try it in your IPA/APA, you might like it.
- Can go as low as 56-57F. 58-62F optimal
- Recommendation: Pitch 58F ^ to 62F ~6 days
- Risks: Sulfur. A long, cool fermentation needs time. Give it that time to finish out.
- Absolutely killer w/ noble hops & pils malt Belma Kölsch
- Fermentis Safale K-97 may be a suitable substitute?

Brettanomyces mythbusters Custersianus

- ECY19 from Al was available for a short while, This strain was originally isolated from Bantu (millet) beer brewery in South Africa.
- Why no Custersianus commonly available commercial cultures? Of what had been isolated the resulting fermentations have not been highly desirable. Chlorophenol anyone?

Brettanomyces mythbusters Naardenensis

- **No commonly available commercial strains Al at ECY had an experimental strain for a while**

  "Brettanomyces naardenensis was originally isolated from a soda producer. “
- **Watch for new homebrew commercial Anomalus and Naardenensis offerings coming soon from The Yeast Bay**

The Yeast Bay

Belma Kölsch

- 95% German Pils
- 5% Vienna
- 20 IBU Simcoe
- 2oz.:5gal of Belma @ flame-out
- WLP029
- 1.050-1.010 5.2% ABV 20 IBU