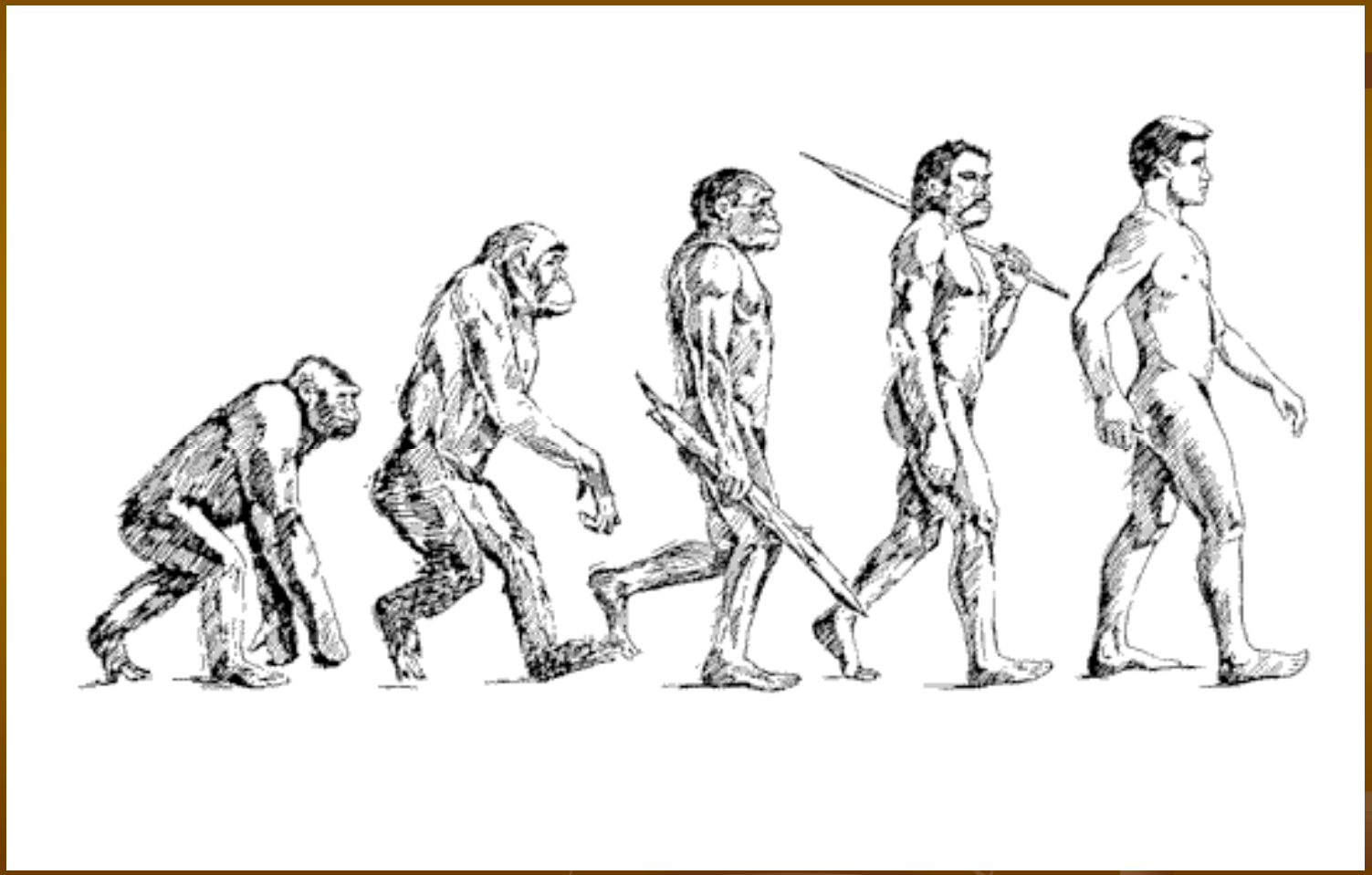
Brewing Great German Lagers:

Finding the perfect balance of traditional and modern techniques in your brewery

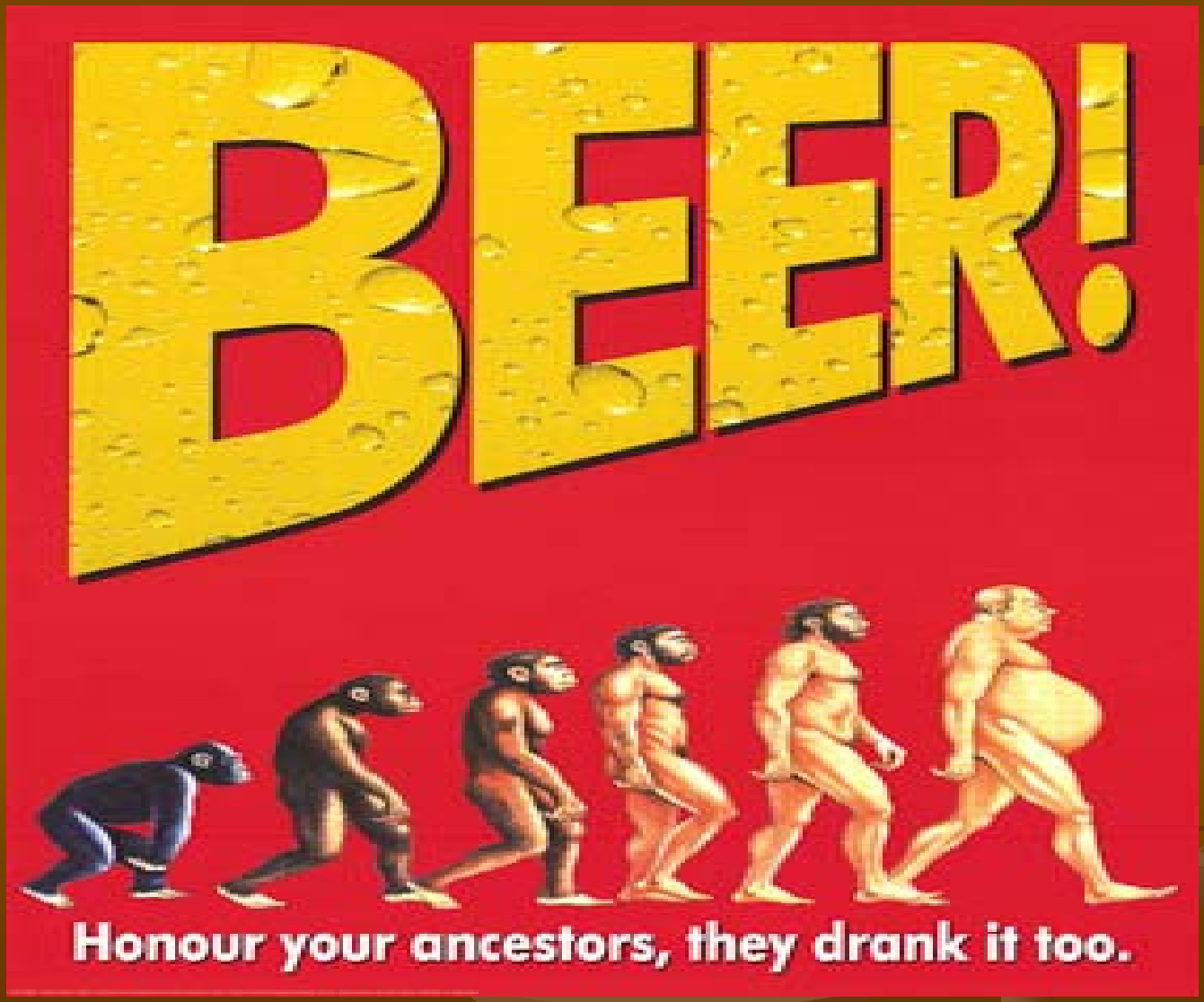
I was a “Lager Lad”

- To me, Lagers were the ultimate styles of Beer

Beer Evolution?

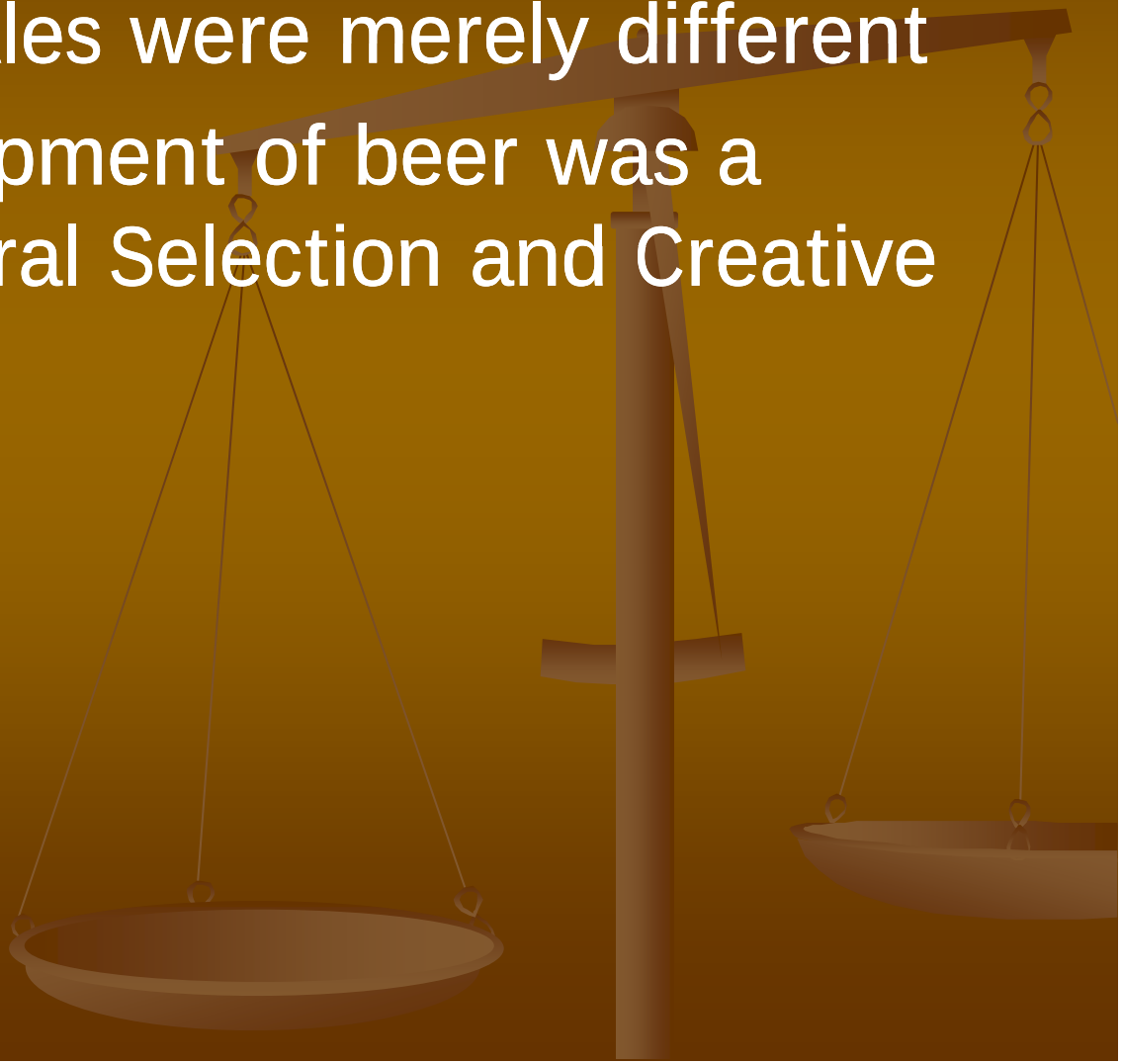


Beer Evolution



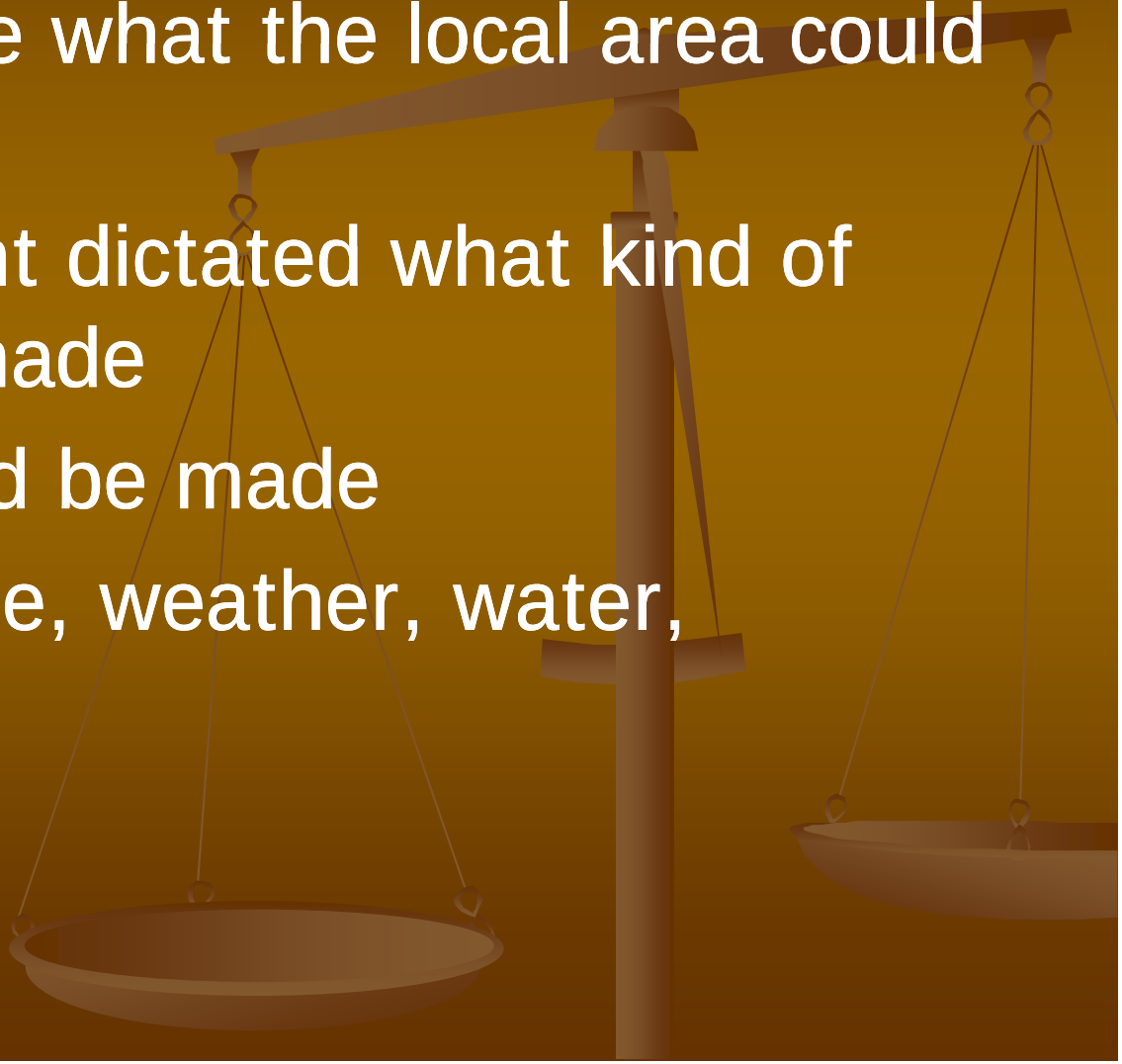
Ales VS Lagers

- I realized that Ales were merely different
- That the development of beer was a process of Natural Selection and Creative Husbandry



Environmental

- Could only make what the local area could provide
- The environment dictated what kind of beer could be made
- And how it could be made
- Location, altitude, weather, water, horticulture etc.

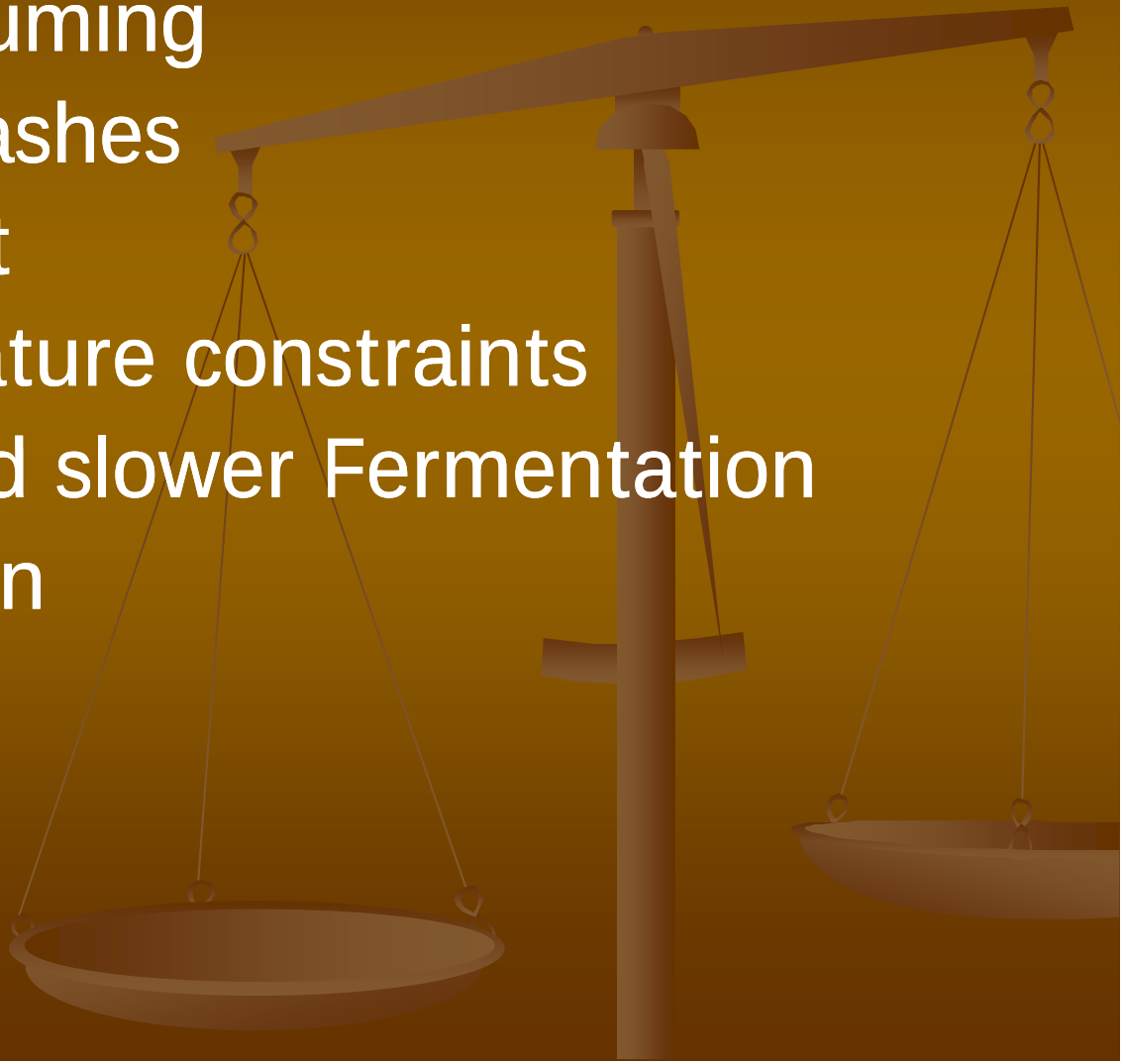


Ales Are Easier

- For home brewers and professionals alike
- Easy infusions
- Shorter fermentation times
- Fewer temperature considerations
- The list goes on

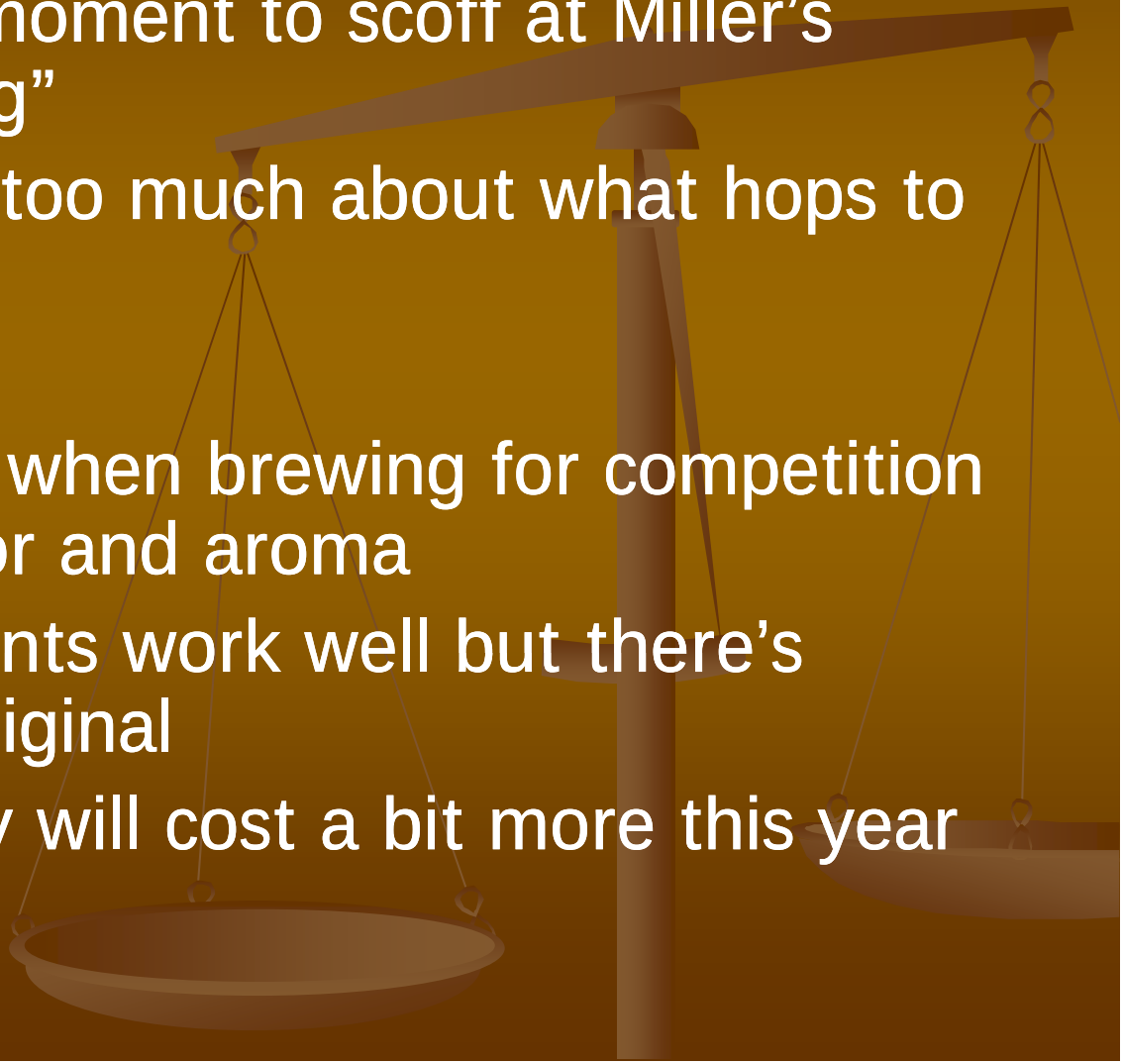
Home Brewing Lagers

- More time consuming
- Difficult step mashes
- More equipment
- Tighter temperature constraints
- Refrigerated and slower Fermentation
- Sulfur production
- DMS
- Etc.



A Word or Two About Hops

- First, let's take a moment to scoff at Miller's "triple hop brewing"
- We will not worry too much about what hops to use.
- Keep it Noble
- Use German hops when brewing for competition especially for flavor and aroma
- American equivalents work well but there's nothing like the original
- Unfortunately they will cost a bit more this year



A Word or Two About Hops

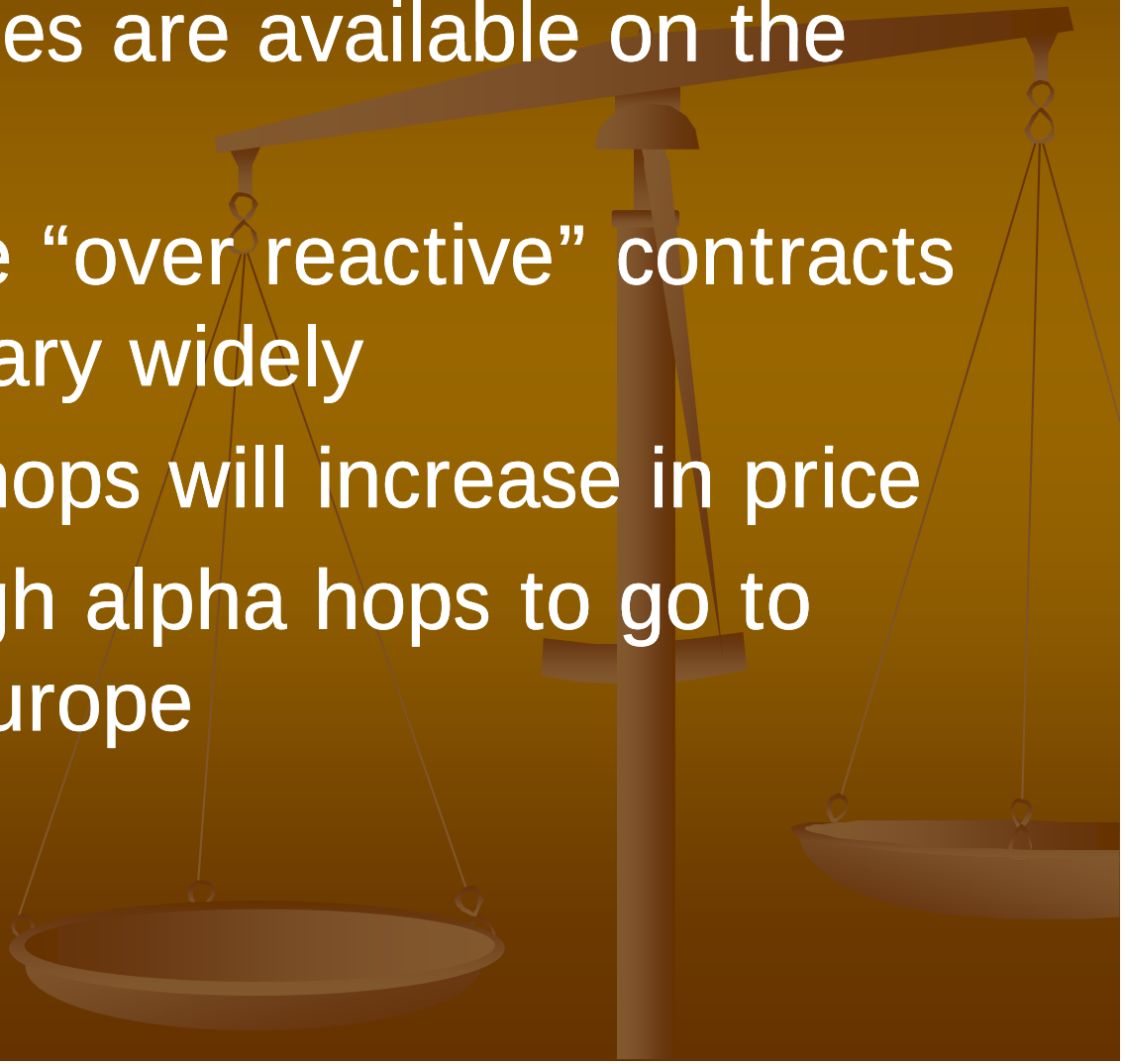
- ***Hallertau and Tettnang region hit hard by wind and hail storm***

  A huge wind and hailstorm caused serious damage to the world's largest hops growing area of Hallertau and Tettnang. Farmers feared at the very least 2,500 hectares of the total 15,000 hectares planted were damaged by heavy rain in the Hallertau region alone.

  In Tettnang it has been reported that as much as 25% of the crop was damaged or destroyed.

Hop Update

- Most hop varieties are available on the spot market
- Due to the large “over reactive” contracts the prices will vary widely
- German Noble hops will increase in price
- Expect more high alpha hops to go to Germany and Europe



Focus

- Equipment
- Water
- Mash Profile
- Mash Techniques
- Extract vs. All Grain

Equipment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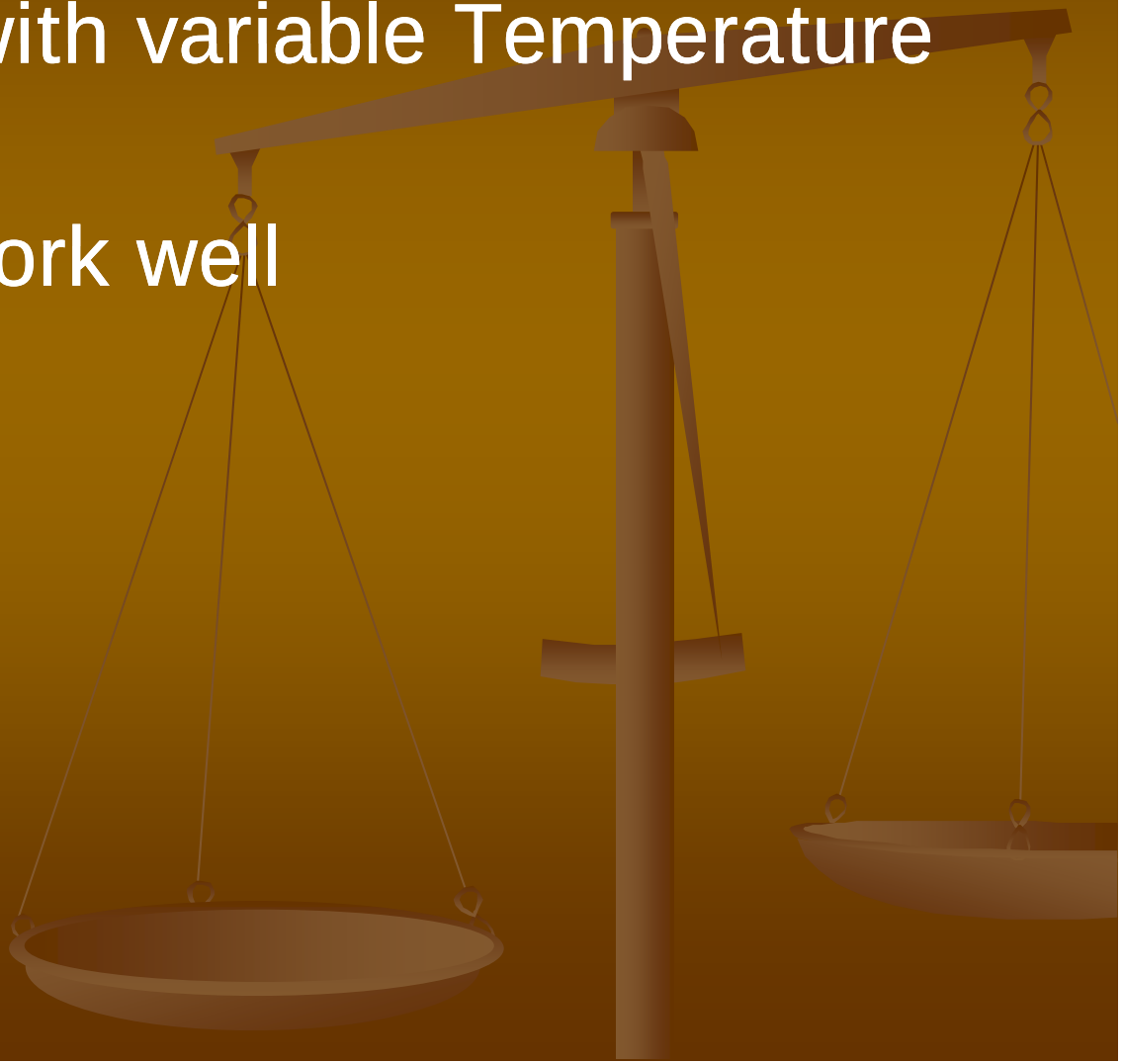
Equipment

Equipment?

Equipment

- A Refrigerator with variable Temperature control
- Chest coolers work well

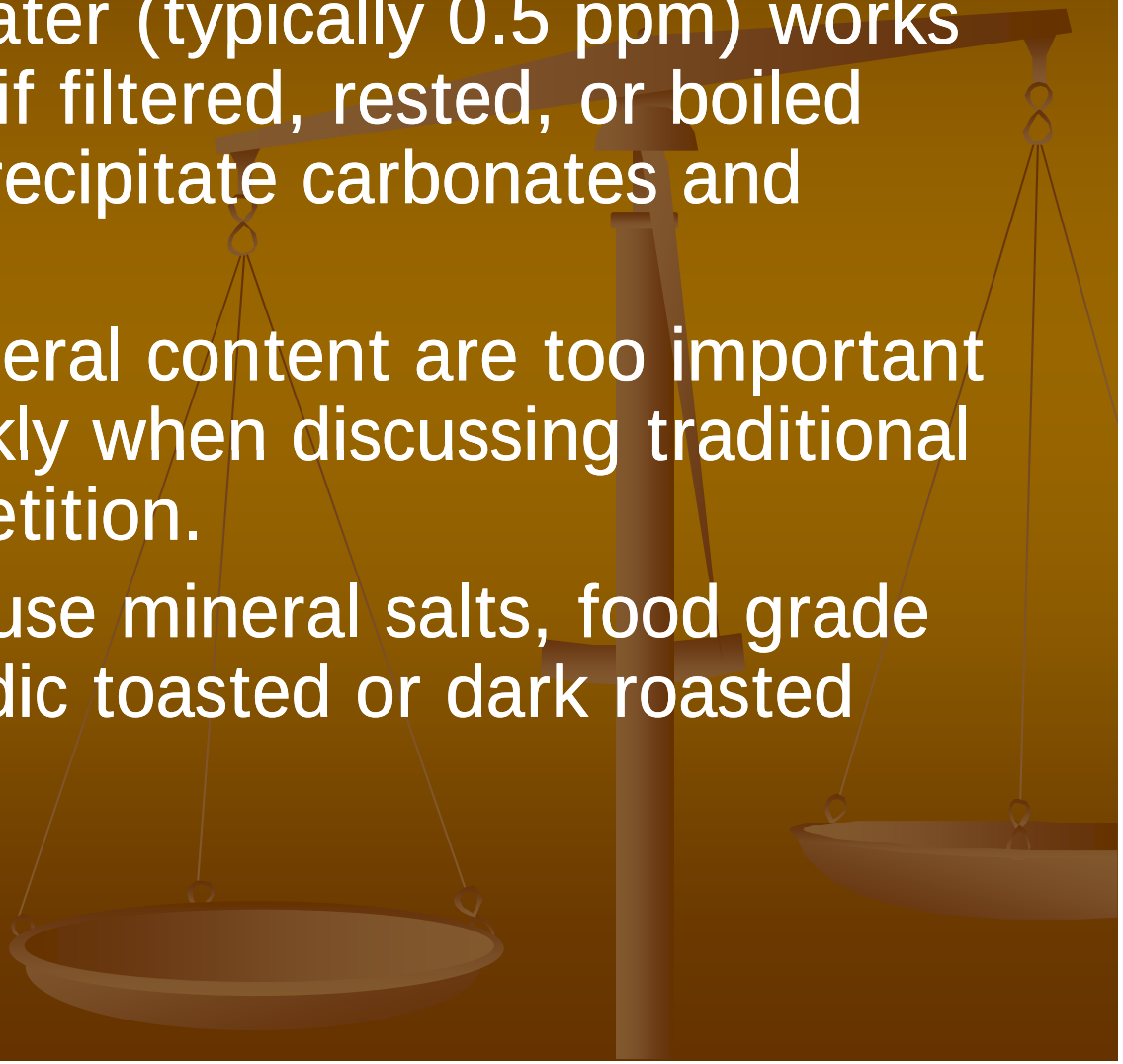


Water

- A lot to too much can be said about water
- “Practically speaking . . . brewing water should be clear, bright, unpolluted, and have an agreeable taste and reasonably uniform composition from day to day. It should not be corrosive, have a detectable odor, or throw an appreciable amount of sediment upon resting or boiling.” –Greg Noonan

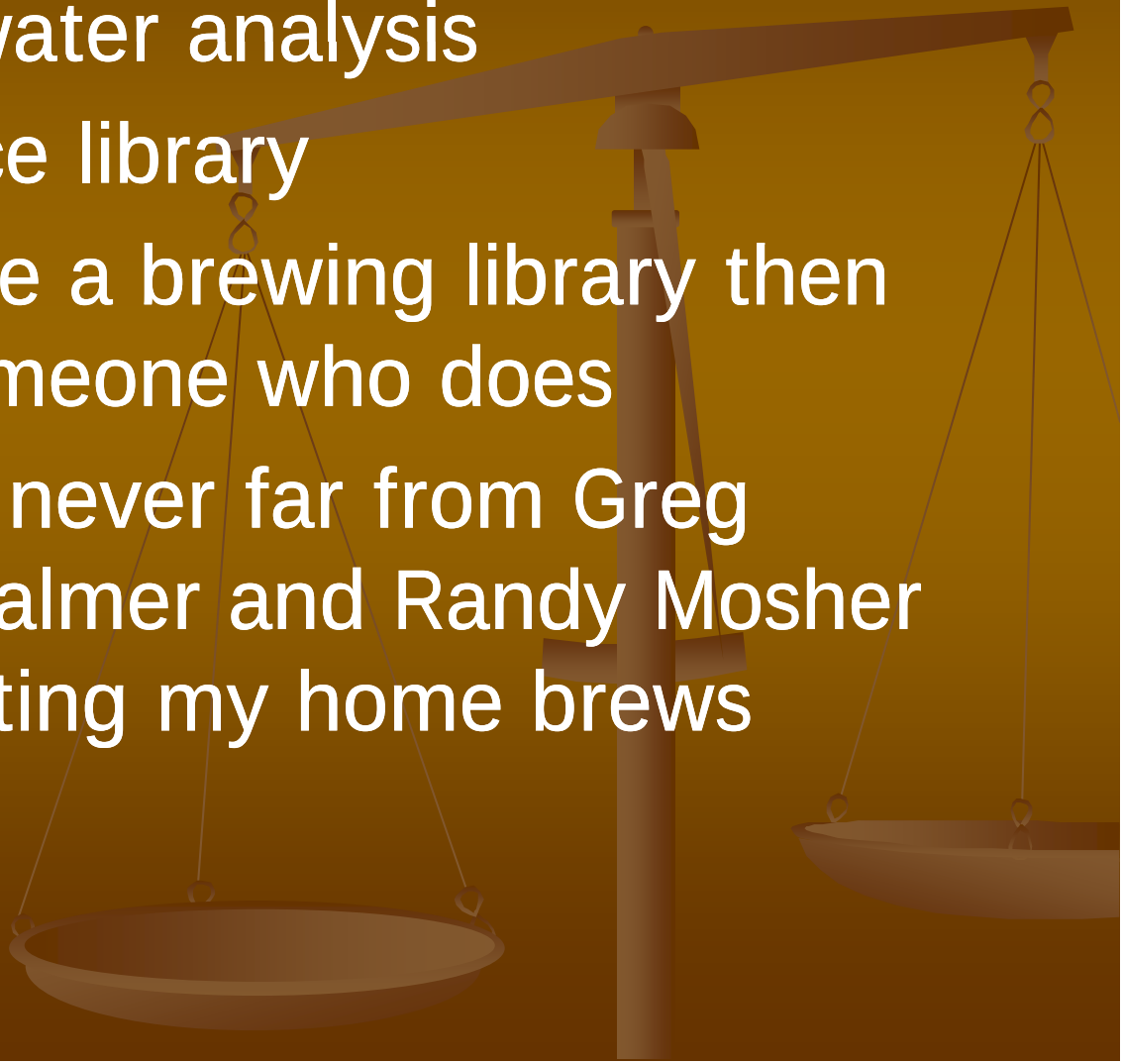
Water

- Chlorinated tap water (typically 0.5 ppm) works great for brewing if filtered, rested, or boiled and aerated (to precipitate carbonates and silicates)
- Water pH and mineral content are too important to gloss over quickly when discussing traditional brewing for competition.
- You may need to use mineral salts, food grade acid, naturally acidic toasted or dark roasted malt



Water

- Use your area water analysis
- Use you resource library
- If you don’t have a brewing library then borrow from someone who does
- Personally I am never far from Greg Noonan, John Palmer and Randy Mosher When I’m targeting my home brews



Mash Profile

- First, a table with some temperatures for the metrically challenged:
- 40C = 104F, glucanase rest (breaks down gummy stuff)
  52C = 127F, Protein rest.
  63C = 145F, Beta amylase rest for dry beers (pils).
  .
  67C = 153F, Beta amylase rest for thick beers (bock).
  72C = 158F, Alpha amylase rest for dry beers (pils).
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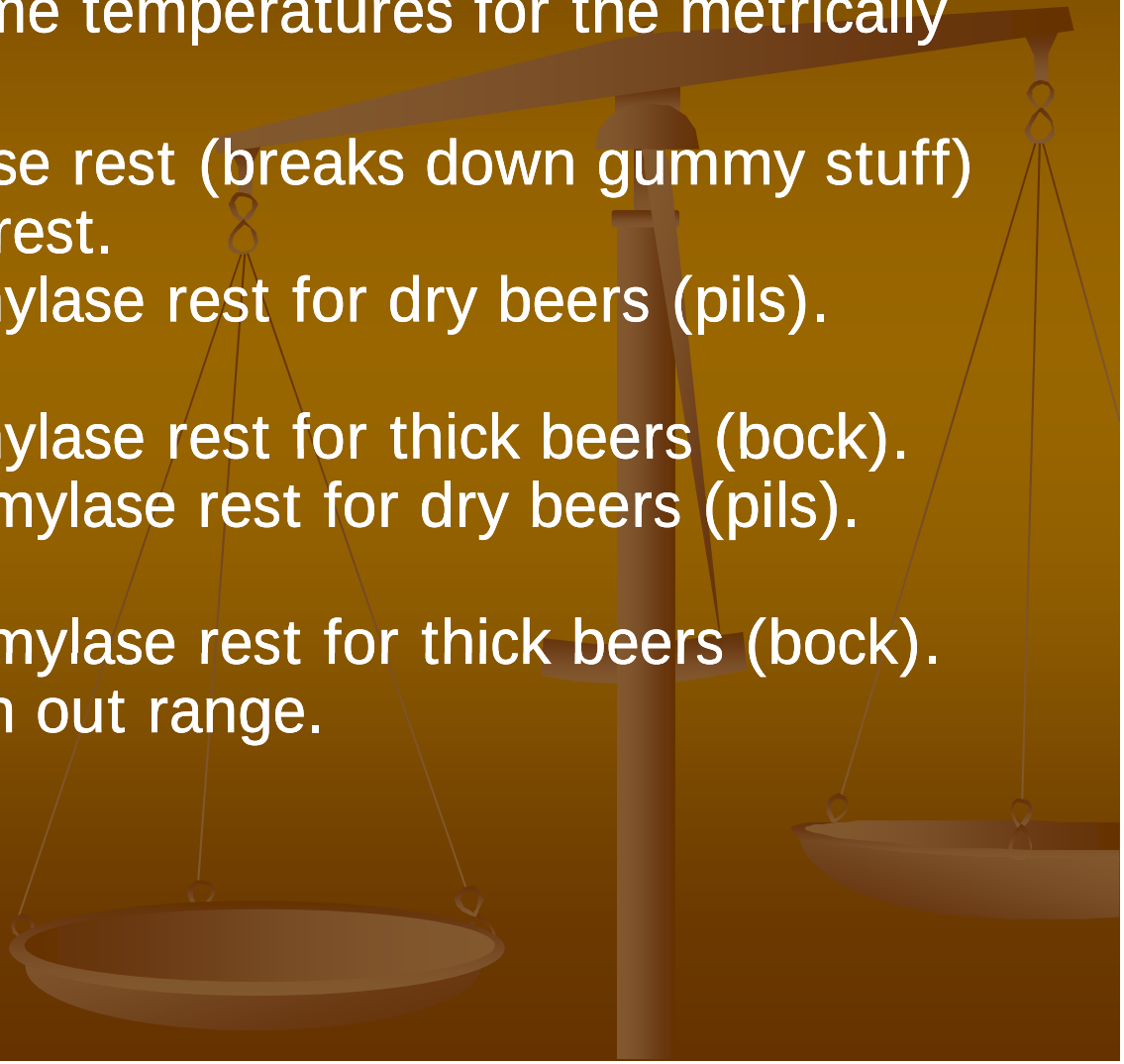
  78+C = 172+F, mash out range.

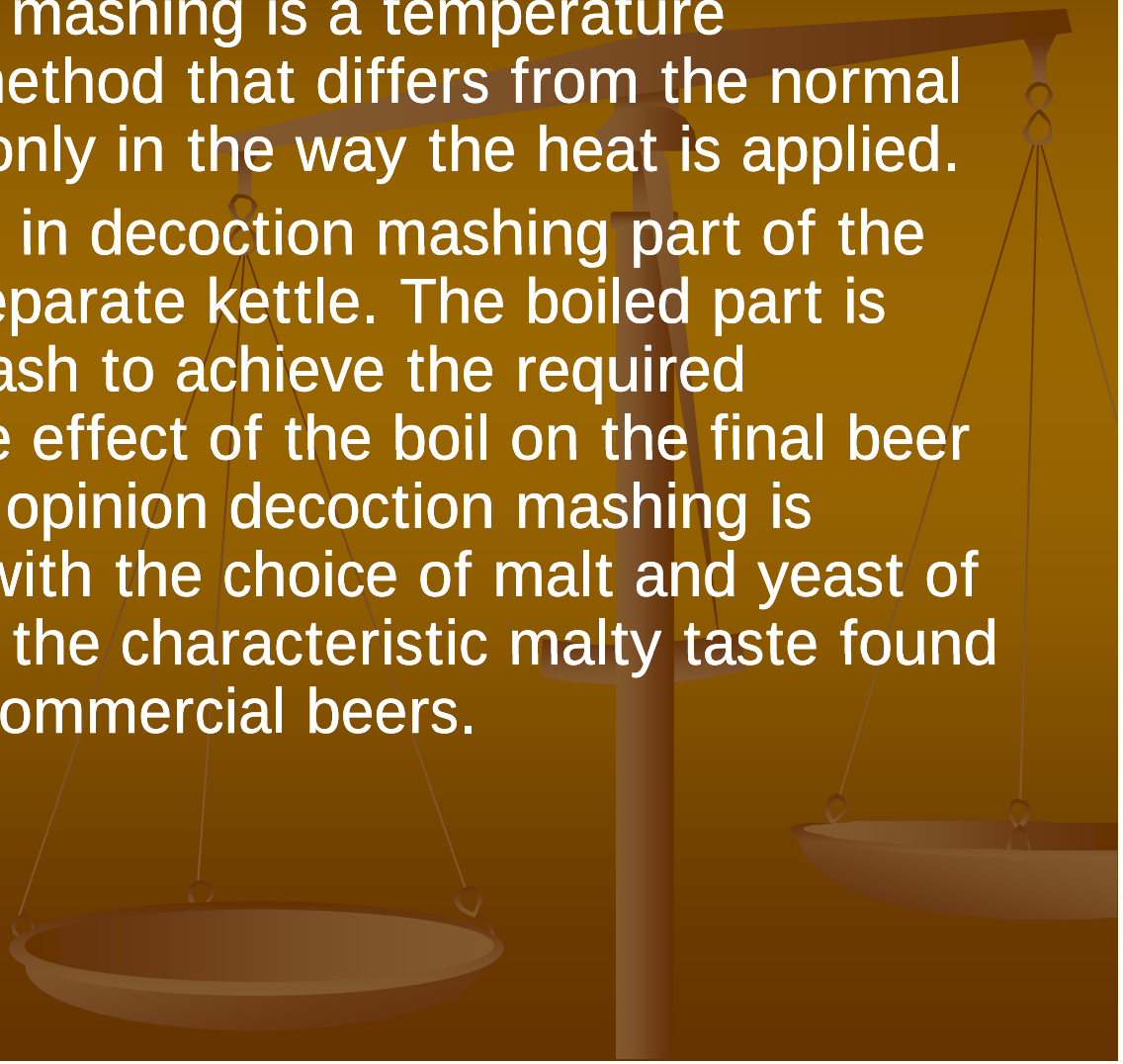


Mash Techniques

- Single Infusion
- Step Mash
- Decoction Mash

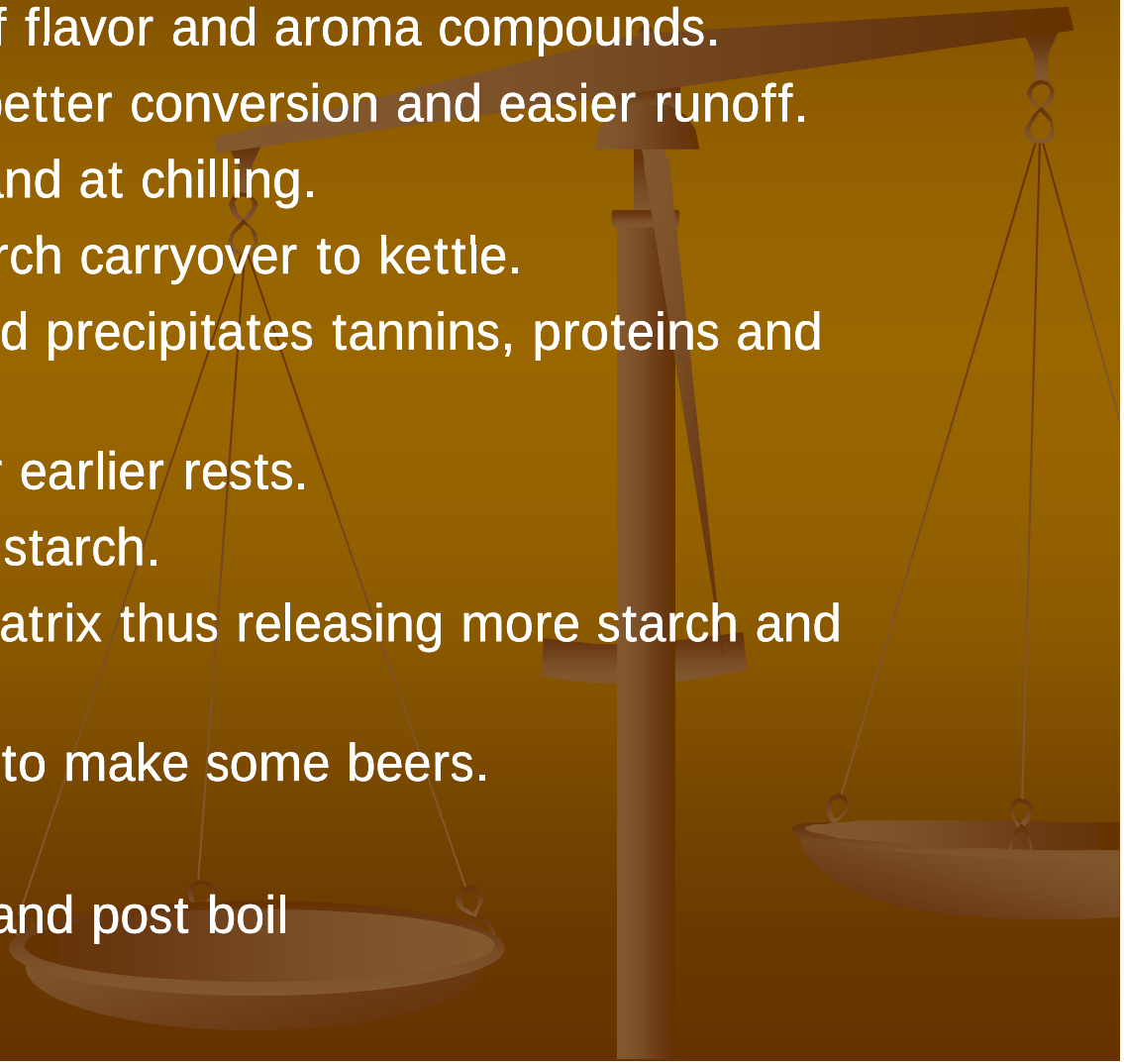
What is decoction mashing?

- In essence decoction mashing is a temperature controlled mashing method that differs from the normal 'step-infusion' mash only in the way the heat is applied.
- The difference is that in decoction mashing part of the mash is boiled in a separate kettle. The boiled part is added back to the mash to achieve the required temperature rise. The effect of the boil on the final beer is very strong. In my opinion decoction mashing is important (together with the choice of malt and yeast of course) for achieving the characteristic malty taste found in many of the best commercial beers.



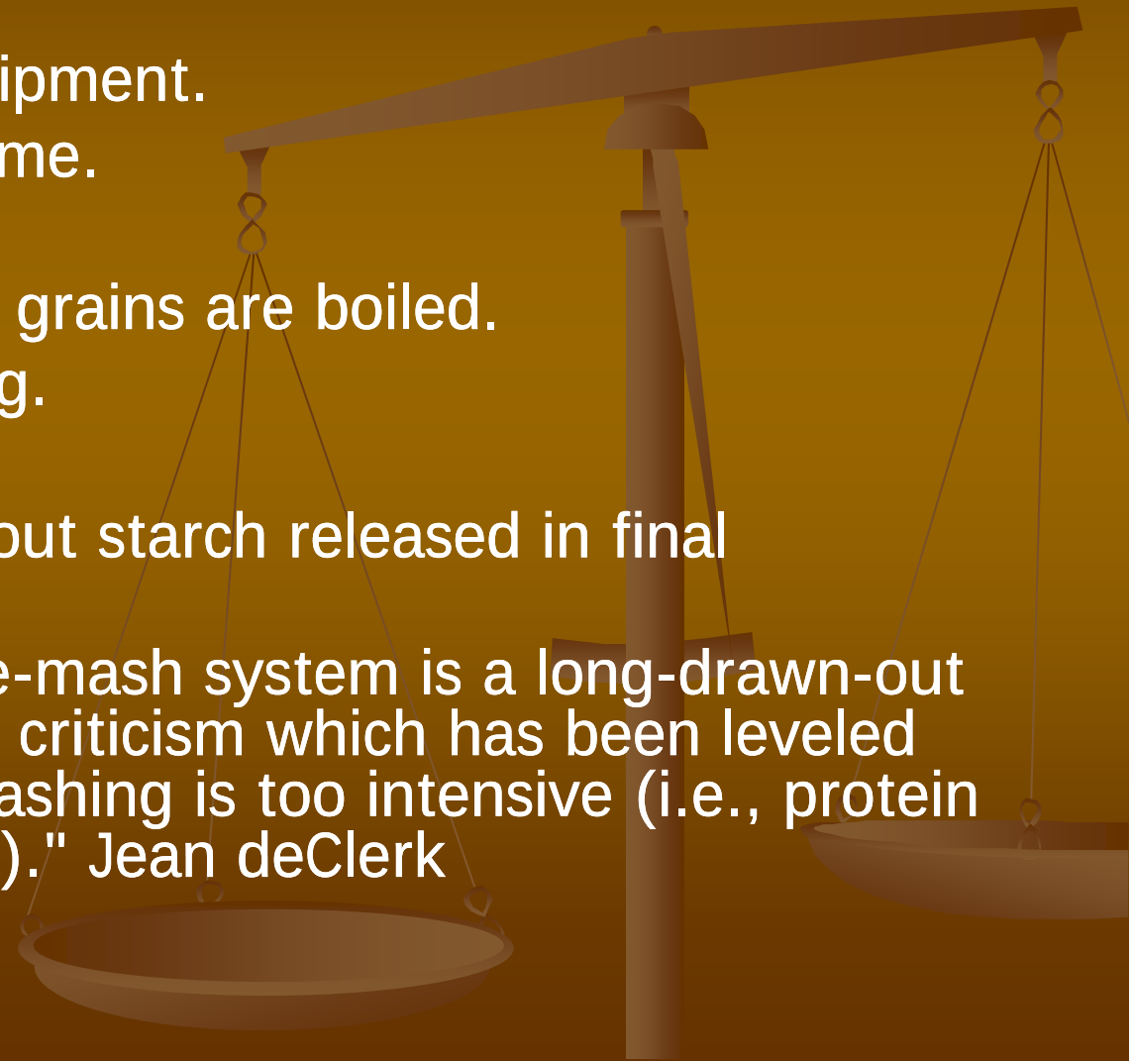
Decoction (Pros)

- Enhances production of flavor and aroma compounds.
- Reduces mash pH for better conversion and easier runoff.
- Less trub in main boil and at chilling.
- Less chance of raw starch carryover to kettle.
- Extracts, coagulates and precipitates tannins, proteins and silicates.
- Allows thicker mash for earlier rests.
- Better gelatinization of starch.
- Breaks down protein matrix thus releasing more starch and improving extraction.
- It's the traditional way to make some beers.
- Darkens Beer
- Much clearer wort pre and post boil



Decoction (Cons)

- Complicated.
- Requires more equipment.
- Takes a lot more time.
- Darkens beer.
- Extracts tannins as grains are boiled.
- Danger of scorching.
- Uses more energy.
- Must be careful about starch released in final decoction.
- "The classical three-mash system is a long-drawn-out affair and the chief criticism which has been leveled against it is that mashing is too intensive (i.e., protein is degraded too far)." Jean deClerk

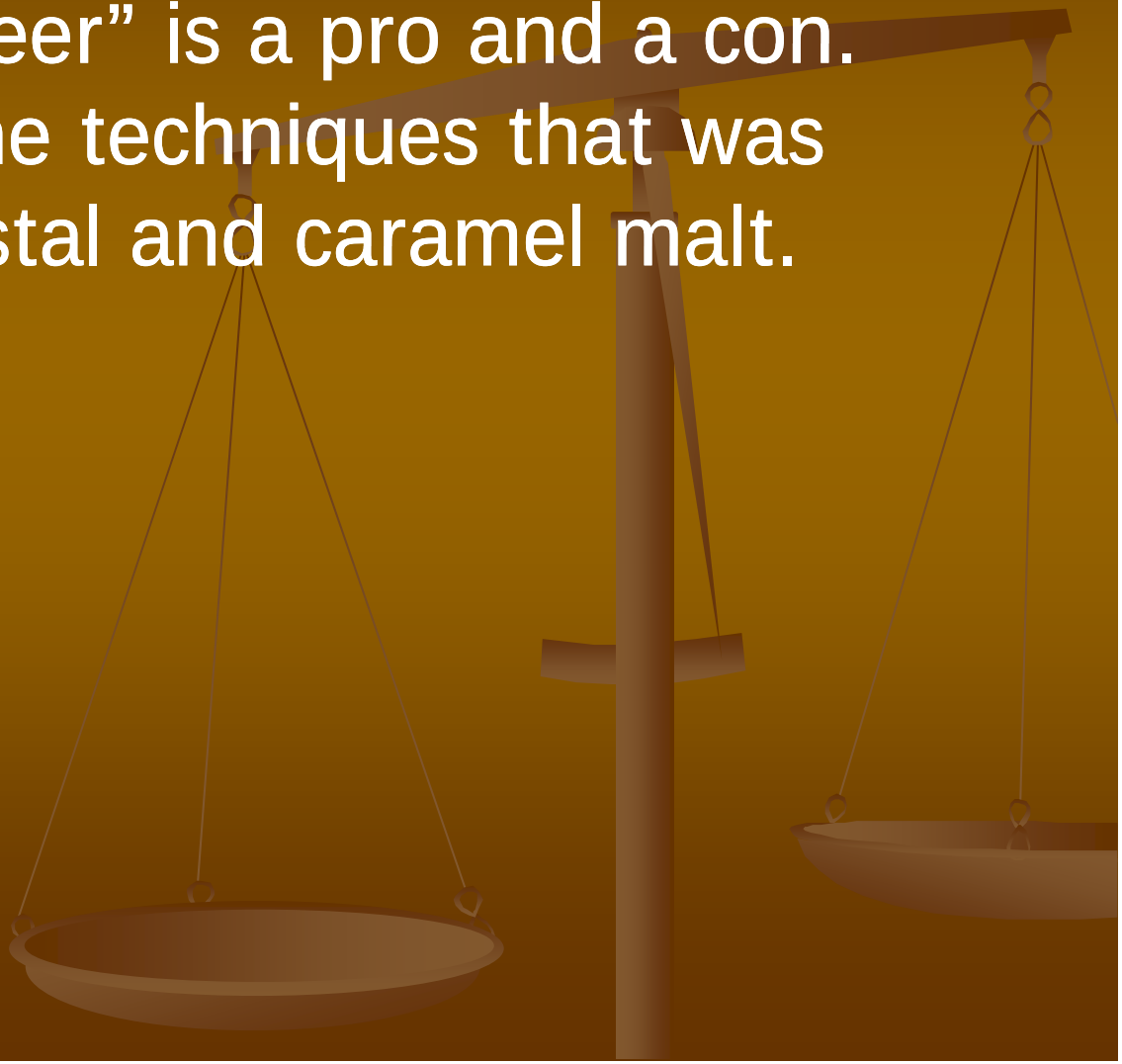


Decoction Pros and Cons

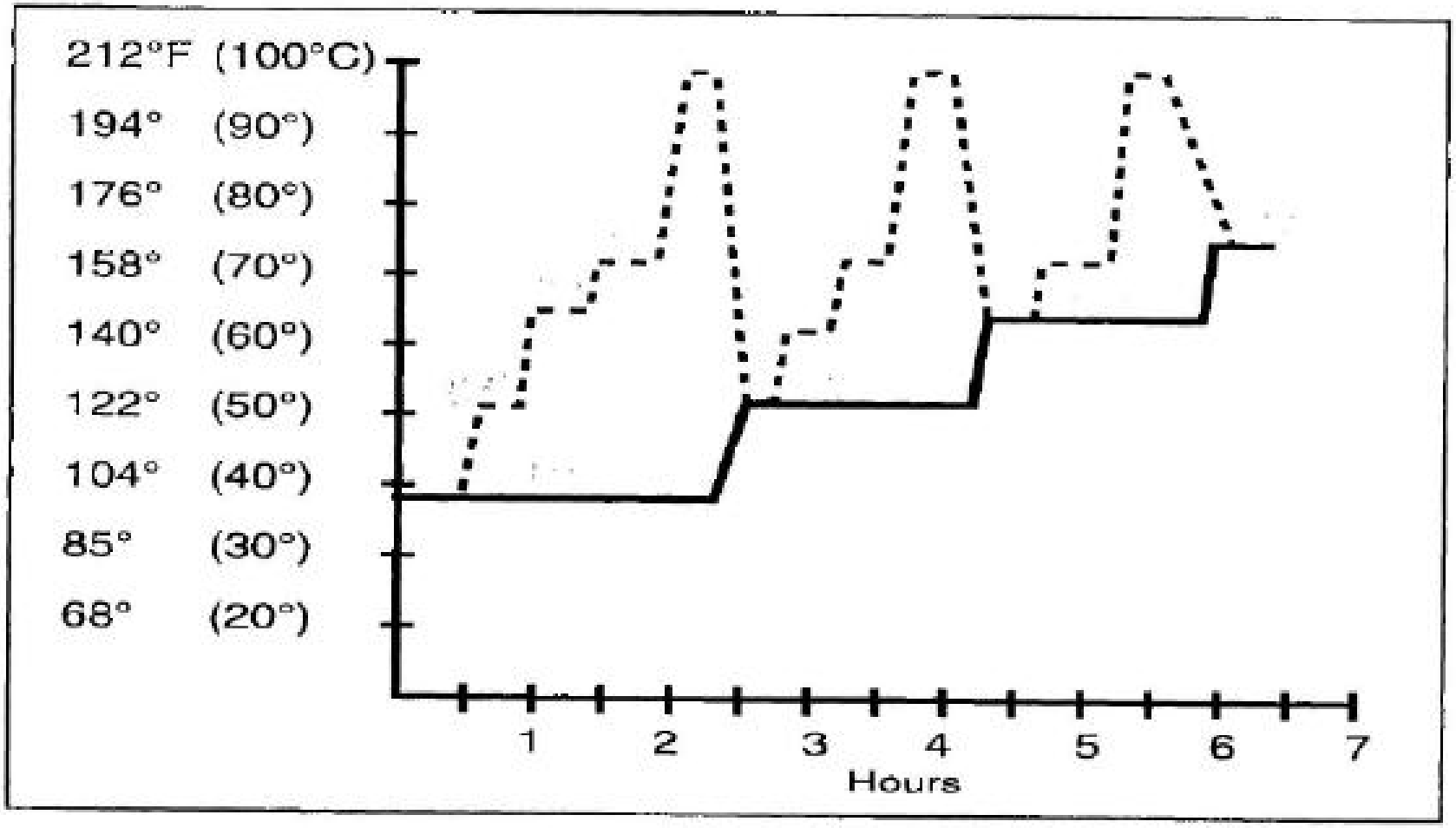
- Note that tannin extraction has been listed as a pro and a con. The good news is that some of it is complex and drops in the decoction in that as the tannins have been largely extracted in the decoction one need not be so careful about sparge temperature and pH. The bad news is that the tannins have been released and long lagering is usually required for them to drop out.

Decoction Pros and Cons

- Also “darkens beer” is a pro and a con. This is one of the techniques that was replaced by crystal and caramel malt.



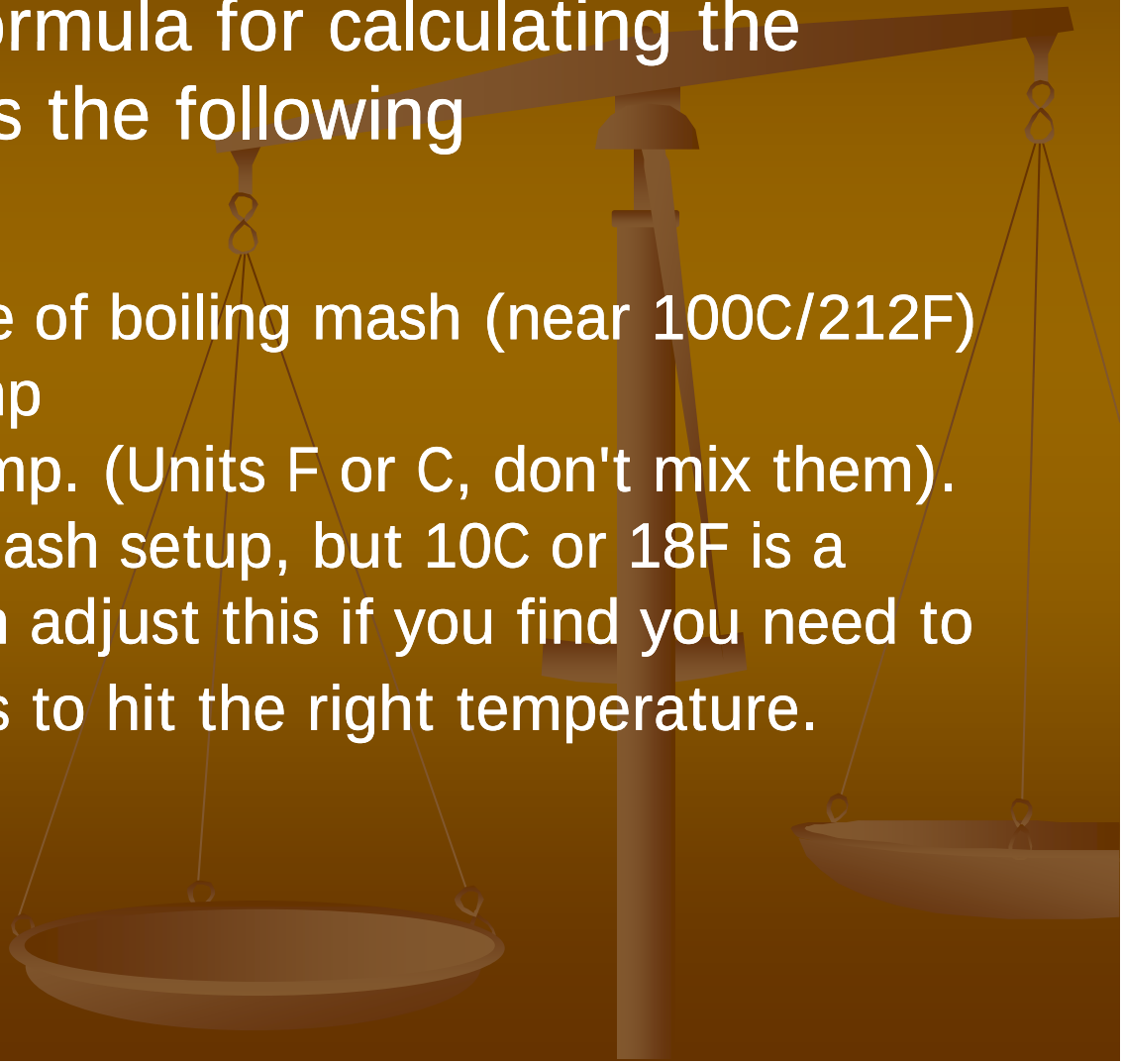
Bock



Mash program at Bavarian State Brewery at Weihen – Stephan: Typical three-decoction mash program.

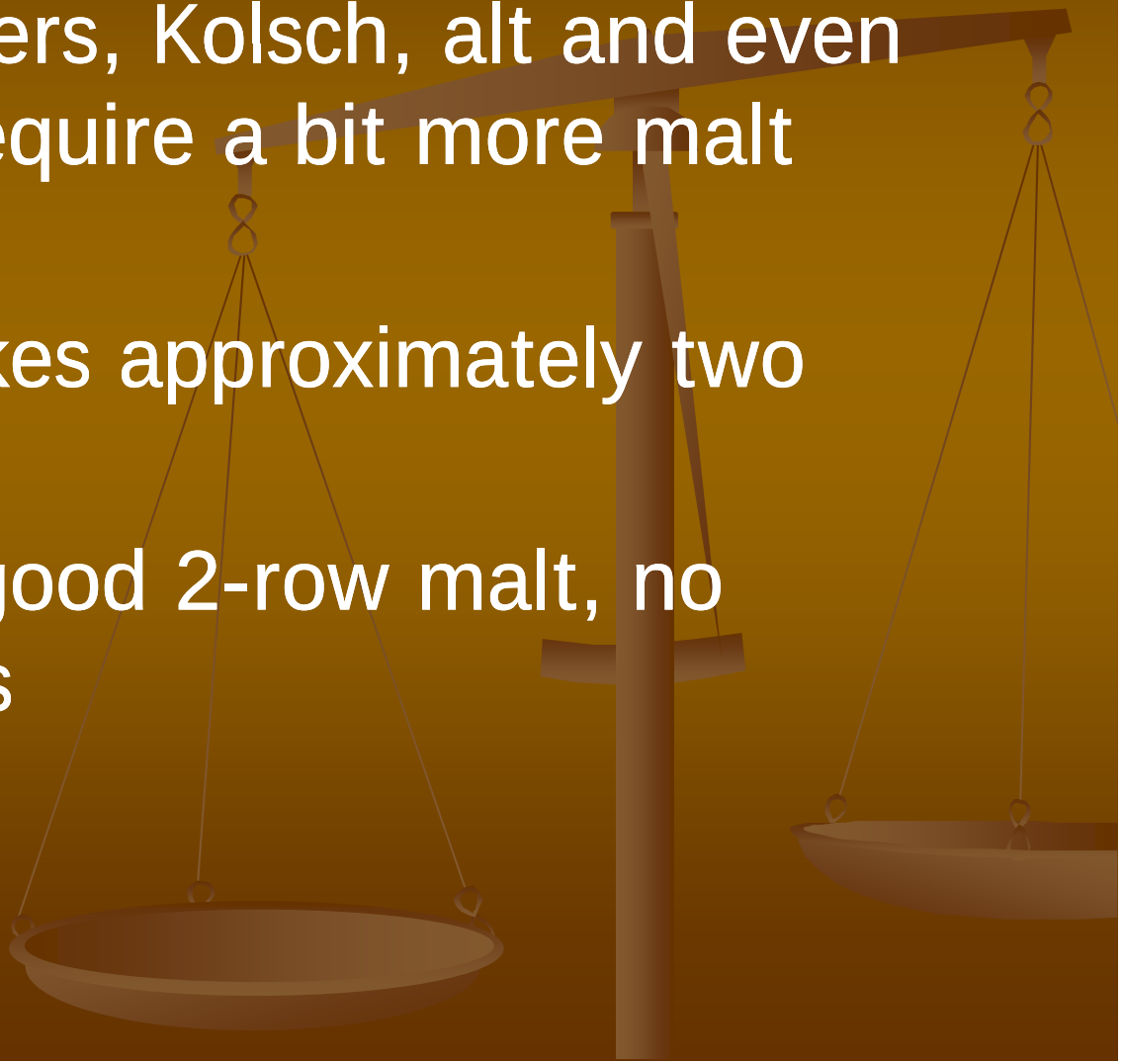
Calculation of Boiling Volume

- An approximate formula for calculating the boiling fraction F is the following
- F=T1-T0/TB-T0-X
- TB is the temperature of boiling mash (near 100C/212F)
  T0 is the starting temp
  T1 is the required temp. (Units F or C, don't mix them).
  X depends on your mash setup, but 10C or 18F is a typical value, you can adjust this if you find you need to boil a lot more or less to hit the right temperature.



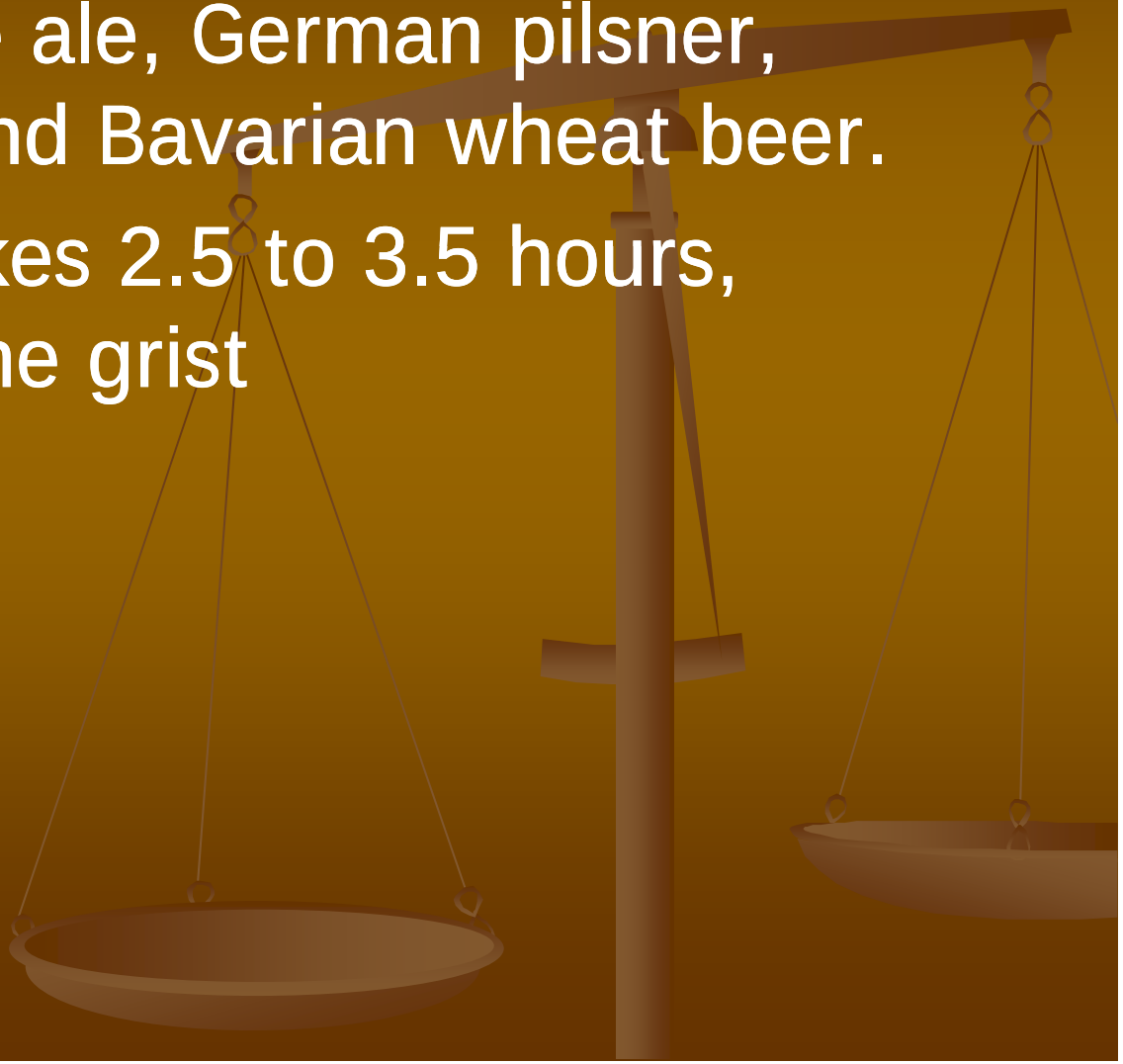
Short 1-step method

- For simple pilsners, Kolsch, alt and even pale ales that require a bit more malt flavor.
- This method takes approximately two hours.
- Preferably use good 2-row malt, no starchy adjuncts



Average 2-step method

- For Belgian pale ale, German pilsner, Munich styles and Bavarian wheat beer.
- This method takes 2.5 to 3.5 hours, depending on the grist

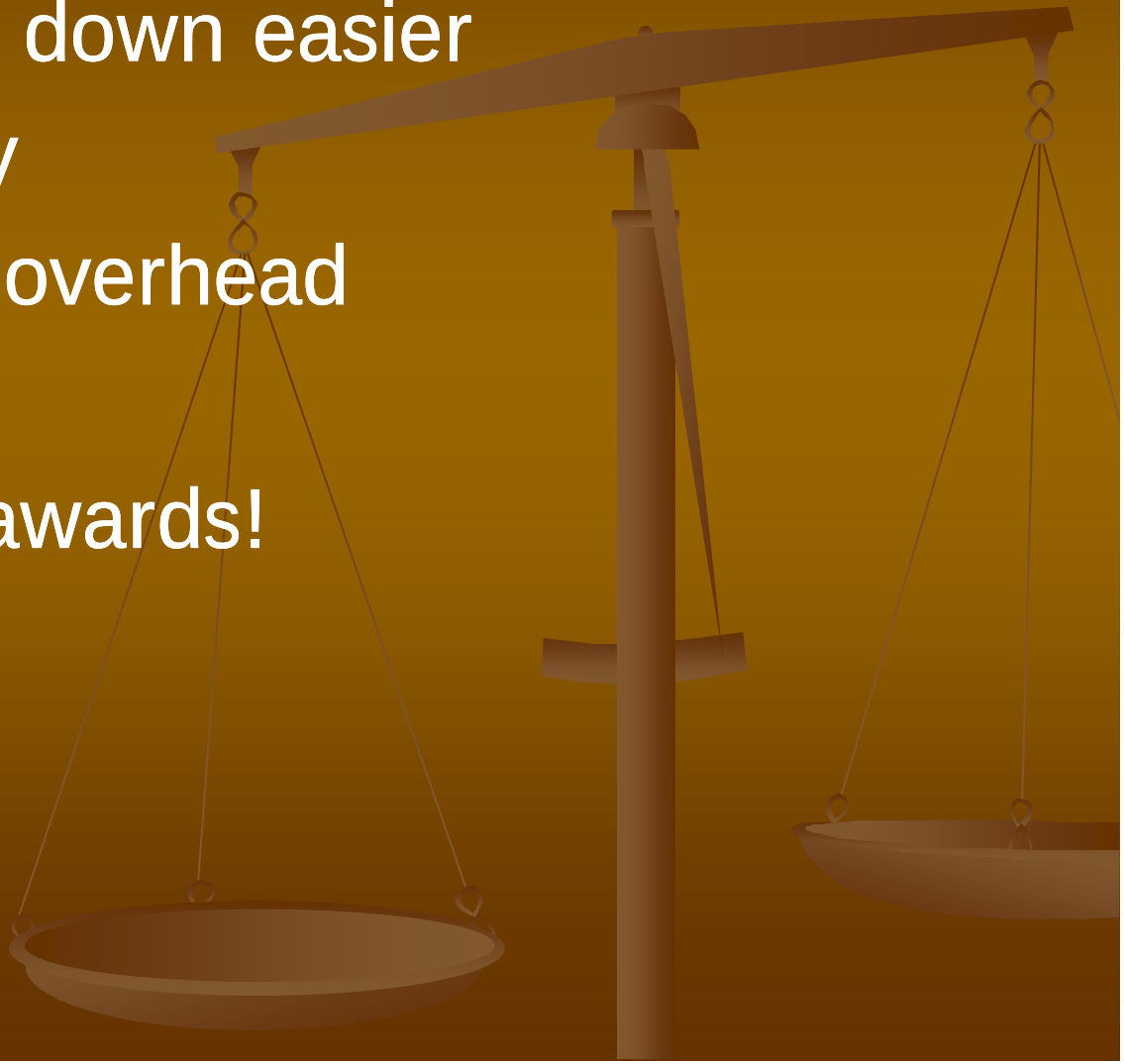


3-step traditional

- (Commercial example from De Clerck, Leerboek *der brouwerij*, Leuven, 1962), this one takes 5 to 6 hours. It is more or less the method used for Pilsner Urquell
- Of Course remember that the final decoction is the thinnest possible part of the mash
- Suggestion for obtaining the thinnest part of the mash for lauter decoction: Use a large kitchen sieve as a stuykmanden, i.e., push it down into the mash and ladle out the liquid

Extract vs. All Grain

- Extract is hands down easier
- 3 hour brew day
- Low equipment overhead
- Great price
- They even win awards!
- But . . .

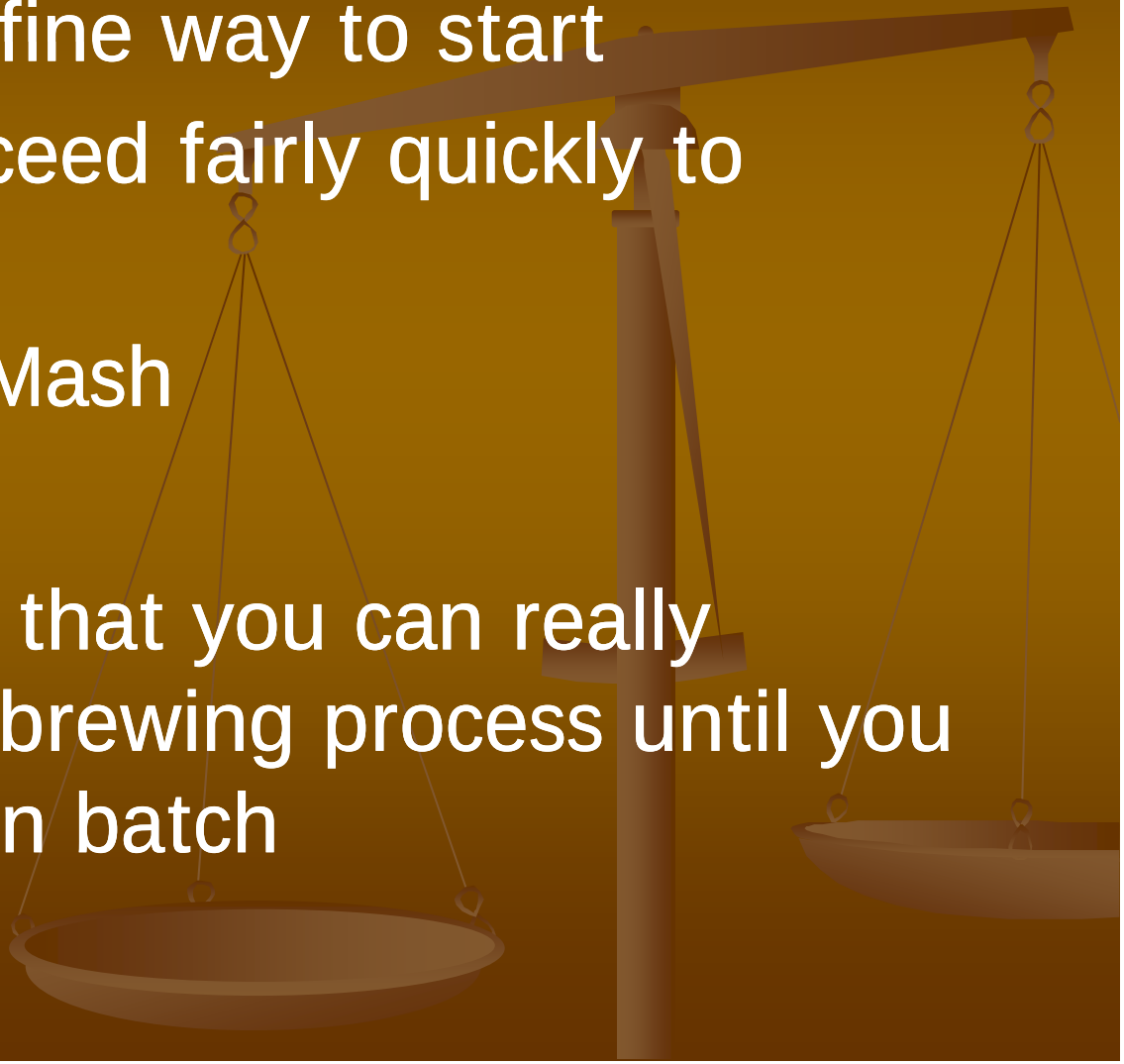


Extract vs. All Grain

- I believe that beer is made in the mash
- To get extract somebody else had to do the mash
- What do you know about your extract?
- Isn’t it more like making Kool Aid

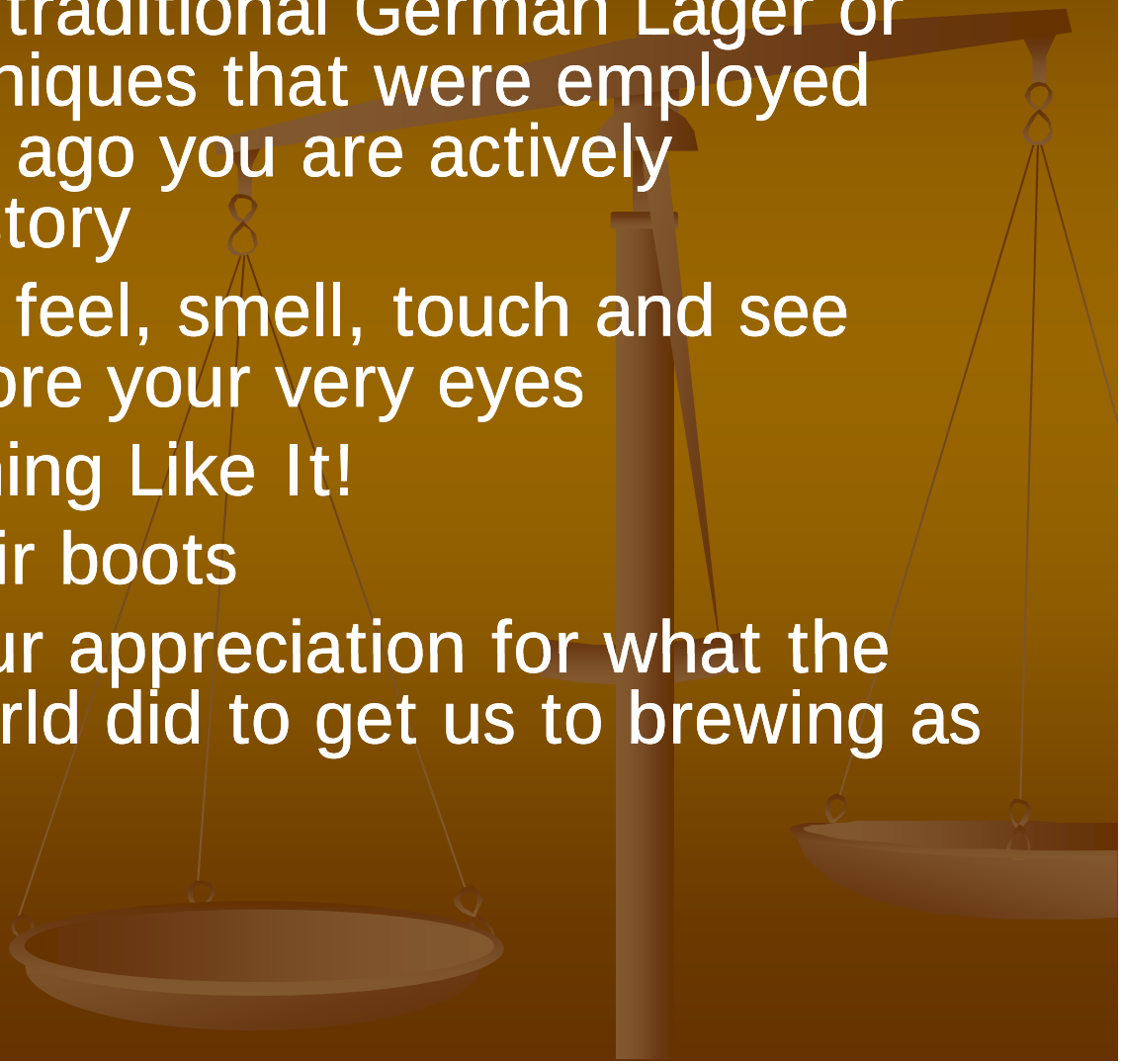
Extract vs. All Grain
My Thoughts

- Okay, yes it's a fine way to start
- One should proceed fairly quickly to Steeping Grains
- Then to Partial Mash
- On to All Grain
- I do not believe that you can really understand the brewing process until you brew an All Grain batch



Traditional Methodology *is* History

- When you brew a traditional German Lager or ale using the techniques that were employed hundreds of years ago you are actively participating in history
- You literally taste, feel, smell, touch and see history unfold before your very eyes
- And There Is Nothing Like It!
- Walk a mile in their boots
- It will increase your appreciation for what the brewers of the world did to get us to brewing as we know it today



So Long For Now

What is decoction mashing?

In essence decoction mashing is a temperature controlled mashing method that differs from the normal 'step-infusion' mash only in the way the heat is applied.

The difference is that in decoction mashing part of the mash is boiled in a separate kettle. The boiled part is added back to the mash to achieve the required temperature rise. The effect of the boil on the final beer is very strong. In my opinion decoction mashing is important (together with the choice of malt and yeast of course) for achieving the characteristic malty taste found in many of the best commercial beers.

What beers are made with decoction mashing?

The decoction method is the preferred mash method for many beer styles originating on the European continent. For example:

- Pilsner and pilsner imitations (From Pilsner Urquell to Bud)
- Almost all German beers (maerzen, bock, weizen, some alts, rye, dortmunder)
- Some of the lighter Belgian ales (De Koninck, Palm, Rodenbach)

Some general considerations

First, a table with some temperatures for the metrically challenged:

40C = 104F, glucanase rest (breaks down gummy stuff)
52C = 127F, Protein rest.
63C = 145F, Beta amylase rest for dry beers (pils).
.
67C = 153F, Beta amylase rest for thick beers (bock).
72C = 158F, Alpha amylase rest for dry beers (pils).
.
75C = 167F, Alpha amylase rest for thick beers (bock).
78+C = 172+F, mash out range.

Strike temperature:

The examples that follow give an indication for the strike temperature, getting this right is often more art than science. In practice (when you use 2.5L/kg or 1.3qt/lb) you add the water at a temperature of 7C or 12F higher than the mentioned value, just like you would for an infusion method.

Calculation of boiling volume:

In the following examples I've indicated what proportions of the mash should be boiled (roughly 1/4 to 1/3). When taking out this fraction, you could try leave behind as much clear wort as possible. However, the risk of scorching increases if you are too zealous. My preferred method: stir well and scoop out the right amount without worrying. This does not go for mashing out, when you only take the clear liquid off the top.

An approximate formula for calculating the boiling fraction F is the following:

$$F = \frac{T1 - T0}{TB - T0 - X}$$

TB is the temperature of boiling mash (near 100C/212F)
T0 is the starting temp
T1 is the required temp. (Units F or C, don't mix them).
X depends on your mash setup, but 10C or 18F is a typical value, you can adjust this if you find you need to boil a lot more or less to hit the right temperature.

Obviously decoction mashing methods can vary as much as anything in brewing, but here are some practical examples. I've used the first three myself; the last is a traditional example.

Short 1-step method

For simple pilsners, Kolsch, alt and even pale ales that require a bit more malt flavor.

This method takes approximately two hours.

Preferably use good 2-row malt, no starchy adjuncts

- Strike temperature 64C, stir well and rest for 20'.
- Stir and immediately put 1/3 of the mash in a pan (the remainder stays at 64C). Slowly heat the pan to 73C, rest for 20'.
- Bring to boil and maintain a good rolling boil for 15-30', beware of scorching.
- Add boiling mash back to the rest, stirring well until temperature is around 72C. (Normally you won't need everything you've boiled, add the remainder when it has cooled down a little). You can add dark malts at this time too, if you want to keep the dextrin level high.
- Rest until saccharification is complete (probably between 30' and an hour, test the clear wort for starch residue).
- No mash-out, start sparge immediately.

Average 2-step method

For Belgian pale ale, German pilsner, Munich styles and Bavarian wheat beer.

This method takes 2.5 to 3.5 hours, depending on the grist.

- Strike temperature of 53C, stir well and rest for 20'
- Stir and take 1/3 of the mash. (If you use a large proportion of unmalted grains you can take less of the mash and add water and dry crushed grains to make up 1/3 of the total volume). Heat to 72C, rest for 20' (malt) to 40' (malt + grains).
- Bring to boil and boil for 15-30'
- Add back to reach a temperature of 65-67C, rest 15-35'
- Take 1/4 of the mash, boil for 15-30'
- Add back to reach a temperature of 70-73C, rest until saccharification is complete (30'-1h).
- No mash-out, start sparge immediately.

3-step method

For extremely poor quality malt and strange adjuncts. This method can take 3 to 6 hours.

(In this example the grist is 45% pilsner malt, 35% buckwheat and 20% unmalted wheat, should I posit the name buckwhiter?)

- Strike water malt and wheat for temperature 53C, rest for 40'
- Boil'porridge' of buckwheat and water during this rest.
- Add this to the mash, for a temperature of 63C (I wanted a dryish beer), and rest for 35'.
- Heat 1/3 to 72C, rest 30' and boil 25'.
- Add to mash for a temperature of 70-72C, rest 50'.
- Take clear liquid off the top, bring to boil and add back for mash-out (5').
- Start sparge.

3-step traditional

(Commercial example from De Clerck, Leerboek *der brouwerij*, Leuven, 1962), this one takes 5 to 6 hours. It is more or less the method used for Pilsner Urquell.

- Strike for 35C, rest 20'.
- Slowly (20') heat 1/3 to 65C, rest up to 25'.
- Slowly bring to boil, boil up to 25'.
- Add back, T=52C, rest 5'.
- Slowly heat 1/3 to boiling, boil up to 25'.
- Add back, T=65C, rest up to 50'.
- Slowly heat 1/3 to boiling, boil 5'.
- Add back for mash out (77C).

Special Thanks to Marc de Jonge

Pros and Cons of Decoction Mashing

Posted to Homebrew Digest #1906, 12/11/95
by A.J. deLange (ajdel@interramp.com)

Pros (in order of importance with today's highly modified malts):

1. Enhances production of flavor and aroma compounds.
2. Reduces mash pH for better conversion and easier runoff.
3. Less trub in main boil and at chilling.
4. Less chance of raw starch carryover to kettle.
5. Extracts, coagulates and precipitates tannins, proteins and silicates.
6. Allows thicker mash for earlier rests.
7. Better gelatinization of starch.
8. Breaks down protein matrix thus releasing more starch and improving extraction.
9. It's the traditional way to make some beers.
10. Darkens Beer

Note that 7 and 8 do become important where wheat malt or raw wheat is used.

Cons:

1. Complicated.
2. Requires more equipment.
3. Takes a lot more time.
4. Darkens beer.
5. Extracts tannins as grains are boiled.
6. Danger of scorching.
7. Uses more energy.
8. Must be careful about starch released in final decoction.
9. "The classical three-mash system is a long-drawn-out affair and the chief criticism which has been leveled against it is that mashing is too intensive (i.e., protein is degraded too far)." Jean deClerk

Note that tannin extraction has been listed as a pro and a con. The good news is that some of it is complex and drops in the decoction in that as the tannins have been largely extracted in the decoction one need not be so careful about sparge temperature and pH. The bad news is that the tannins have been released and long lagering is usually required for them to drop out.

Also "darkens beer" is a pro and a con. This is one of the techniques that was replaced by crystal and caramel malt.

Suggestion for obtaining the thinnest part of the mash for lauter decoction: Use a large kitchen sieve as a stuykmanden, i.e., push it down into the mash and ladle out the liquid.

50 Steps of happiness:

1) Mash-in with water @ 110°F. (1.4 Quarts per pound of grain)

2) Let rest for 20 minutes

Decoction - First Stage

3) Use a container with a handle to remove the thicker portion of 1/3-1/2 of the total mash from the bottom of the tun

4) Heat the decoction, stirring frequently over 10 minutes, to 127°F

5) Let rest for twenty minutes

6) Heat, stirring frequently over 10 minutes, to 149°F

7) Let rest for another 20 minutes

8) Heat, stirring frequently over 10 minutes, to 167°F

9) Let rest for yet another 20 minutes

10) Heat, stirring frequently over 10 minutes, to boiling

11) Let boil for 30 minutes. Stir frequently, but try not to aerate the mix.

12) Add the boiling mixture steadily back to the main mash, making sure not to aerate

13) Let the mash rest at 127°F for 30 minutes

Decoction - Second Stage

14) Use a container with a handle to remove the thicker portion of 1/3-1/2 of the total mash

15) Heat, stirring frequently over 10 minutes, to 149°F

16) Let rest for another 20 minutes

17) Heat, stirring frequently over 10 minutes, to 167°F

18) Let rest for yet another 20 minutes

19) Heat, stirring frequently over 10 minutes, to boiling

20) Let boil for 30 minutes. Stir frequently, but try not to aerate the mix.

21) Add the boiling mixture steadily back to the main mash, making sure not to aerate

22) Let the mash rest at 149°F for 30 minutes

Decoction - Third Stage

23) Use a container with a handle to remove the thicker portion of 1/3-1/2 of the total mash

24) Heat, stirring frequently over 10 minutes, to 167°F

25) Let rest for yet another 20 minutes

26) Heat, stirring frequently over 10 minutes, to boiling

27) Let boil for 30 minutes. Stir frequently, but try not to aerate the mix.

28) Add the boiling mixture steadily back to the main mash, making sure not to aerate

29) Let the mash rest at 167°F for 20 minutes

30) Recirculate until the wort runs clear

31) Runoff until you can see the level of the water about 1/8" from the top of the grain-bed

Sparge - First Stage

32) Add ½ Quart / Pound of grain at 170°F into the mash and mix thoroughly

33) Recirculate until the wort runs clear

34) Runoff until you can see the level of the water about 1/8" from the top of the grain-bed

Sparge - Second Stage

35) Add just less than 1 Quart / Pound of grain @ 170°F to the mash and mix thoroughly

36) Recirculate until the wort runs clear

37) Runoff until you can see the level of the water about 1/8" from the top of the grain-bed

Sparge - Third Stage

38) Add ½ Quart / Pound of grain at 170°F into the mash and mix thoroughly

39) Recirculate until the wort runs clear

40) Runoff until you collect your final volume of wort in the kettle, or your runoff reaches 1.010

41) Heat wort to boiling and monitor the evaporation rate

42) When the current evaporation says that you have about 1 hour & 15 minutes from reaching your target volume, add the bittering Hops

43) Add Irish Moss at 20minutes until the end of the boil.

44) Insert immersion chiller, or run boiling water through the counter-flow chiller to sanitize

45) 10-15 minutes before stopping the boil, add the last addition of Hops

46) Turn off the heat, and chill the wort as quickly as possible.

47) Collect & aerate in fermentation vessel, and pitch 4-5 times as much yeast as would be required by an average beer.

48) Ferment at 45ºF for about two-weeks (Until the top of the beer is still with very little foam)

49) Rack into a secondary fermenter, being careful as not to introduce any Oxygen

50) Ferment at 33-34ºF for a minimum of two months

Jonathan Goudy's Masochator DoppelBock

A ProMash Recipe Report

Recipe Specifics

Batch Size (Gal):	10.00	Wort Size (Gal):	10.00
Total Grain (Lbs):	29.24		
Anticipated OG:	1.081	Plato:	19.45
Anticipated SRM:	16.9		
Anticipated IBU:	32.3		
Brewhouse Efficiency:	75	%	
Wort Boil Time:	150	Minutes	

Grain / Extract / Sugar

%	Amount	Name	Origin	Potential	SRM
75.2	22.00 lbs.	Munich Malt	Germany	1.037	8
13.7	4.00 lbs.	Pilsener	Germany	1.038	2
6.8	2.00 lbs.	Cara-Pils Dextrine Malt	Germany	1.033	2
3.4	1.00 lbs.	Crystal 75L	Germany	1.034	75
0.8	0.24 lbs.	Chocolate Malt	France	1.032	350

Potential represented as SG per pound per gallon.

Hops

Amount	Name	Form	Alpha	IBU	Boil Time
2.00 oz.	Tettnanger Pellets	Pellet	4.90	23.0	90 min
2.00 oz.	Tettnanger Pellets	Pellet	4.90	7.0	20 min
1.00 oz.	Hallertauer Tradition	Whole	5.70	2.2	10 min

Yeast

White Labs WLP833 Southern Bock Lager Yeast

Mash Schedule

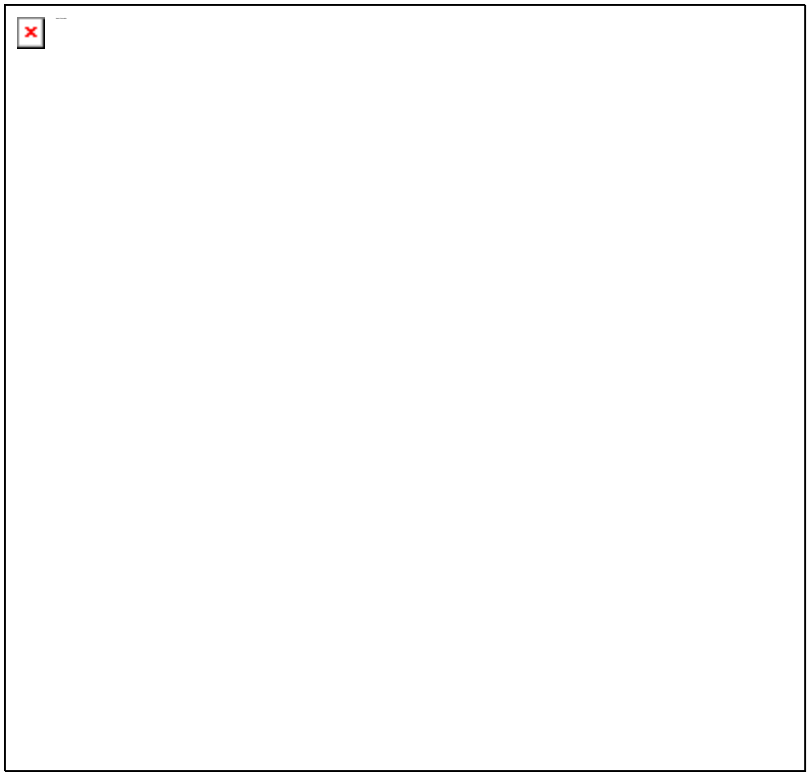
Mash Name:		Masochator Mash
Total Grain Lbs:	29.24	
Total Water Qts:	40.94	Before Additional Infusions
Total Water Gal:	10.23	Before Additional Infusions
Tun Thermal Mass:	0.00	
Grain Temp:	80.00 F	

Step Name	Step Time	Rest Time	Start Temp	Stop Temp	Heat Type	Infuse Temp	Infuse Amount	Infuse Ratio	
Acid Rest	5	150	100	98	Infuse	102	40.94	1.40	
Protein Rest	120	120	127	126	Decoc	212	13.14	1.00	(Decoc Thickness)
Saccarification Re	90	90	149	148	Decoc	212	13.81	1.00	(Decoc Thickness)
Mash-Out	60	30	167	167	Decoc	212	14.98	1.40	(Decoc Thickness)

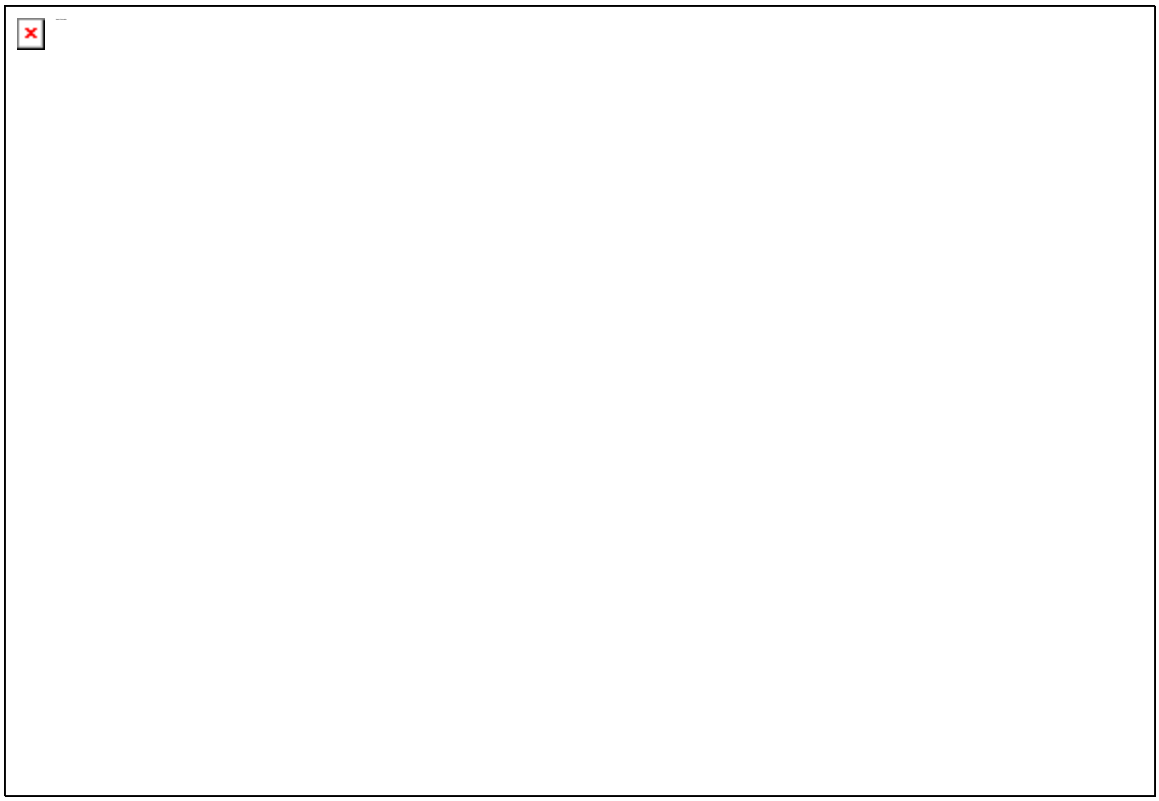
Total Water Qts:	40.94	After Additional Infusions
Total Water Gal:	10.23	After Additional Infusions
Total Mash Volume Gal:	12.57	After Additional Infusions

All temperature measurements are degrees Fahrenheit.
All infusion amounts are in Quarts.
All infusion ratios are Quarts/Lbs.

Step Time for Decoction Steps represent how far back in time the Decoction was pulled.
Infusion amounts for Decoction Steps represent the amount pulled for the Decoction.
Infusion ratios for Decoction Steps represent the Decoction Thickness.



If the chart generator had a brain, the decoction spikes would look like this...resting at 127, 149, and 162.



Notes

Add Chocolate Malt in after last decoction stage