

# EB's HBB

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## My homebrew breviary

### Introduction

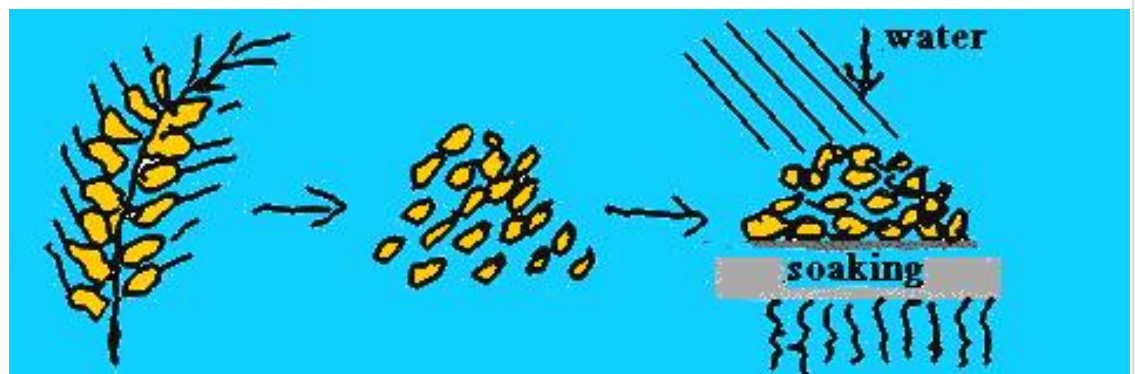


The intention of this breviary is to make you interested in this special hobby. The idea to write it down came when I introduced my American relative Terry to the matter and I am proud to tell you that he does a good job ( I already tested his beer !!) and always when he is visiting us we are doing a brew together. There are a lot of internet publications on homebrewing. The only litterature recommendation I want to give you is a book of Charlie Papazian 'Joy of Home Brewing' ISBN 0-06-053105-3 that Terry showed me last time. I got it at amazone's. -> This breviary will give you only a short overview on how you can start and what you have to do.

*First look at an*  
[overview table](#)  
*of the whole process.*

Now you can examine the process steps more detailed:

- [barley grains, malt, grinding, mashing, lautering](#)



from barley to malt grains (a job for malt factories)

cont., mashing

\*\*\*\*

instr.sheet: mashing

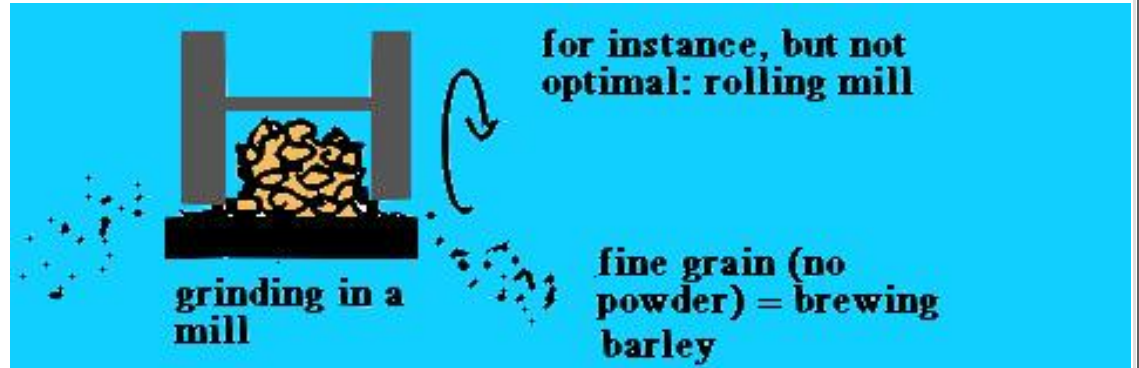
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[pdf file](#)



from barley to malt grains (a job for malt factories)



grinding the grains to brewing malt grains (first point of entry for homebrewers)

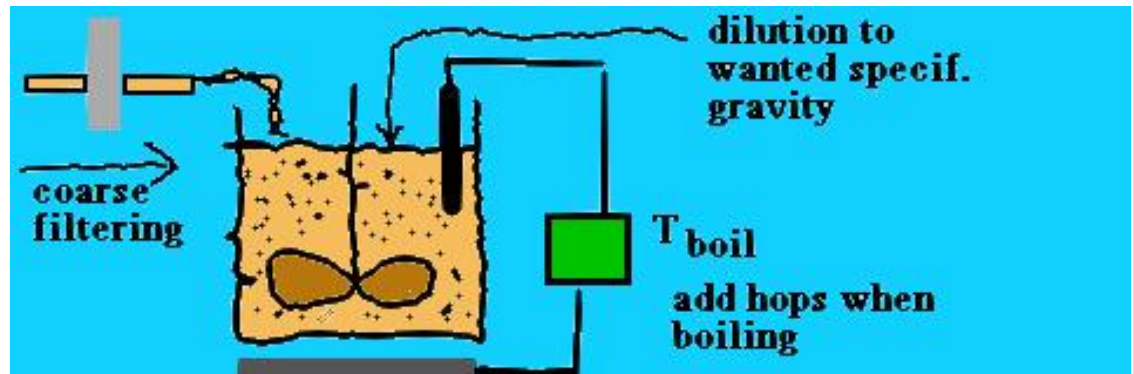


mashing = conversion of starch to malt sugars (second point of entry)



lautering = separation of the sugar solution from the mash

- [boiling the wort, trub filtration, chilling the wort](#)



boiling the wort (malt sugar solution + hops / takes about 1 hour) (third point of entry)

rest of images follows soon!

- [primary fermentation, secondary fermentation, racking, carbonisation](#)

perhaps you are interested now in some *closer details* and informations on 'how it works', here the next step:

- [from barley malt to sugars, the boil, the fermentation](#)
- 

and what about the equipment?:

- [from grinding the grains to chilling the wort](#)
- [primary and secondary fermentation](#)

instruction sheet (going stepwise back starting from the last 'point of entry' for homebrewers):

- [fermentation](#)
- [fermentation continued, cooking the boil](#)
- [cooking the boil continued, mashing](#)
- [mashing continued](#)

could be continued, - depends on feedback that motivates for work !!!

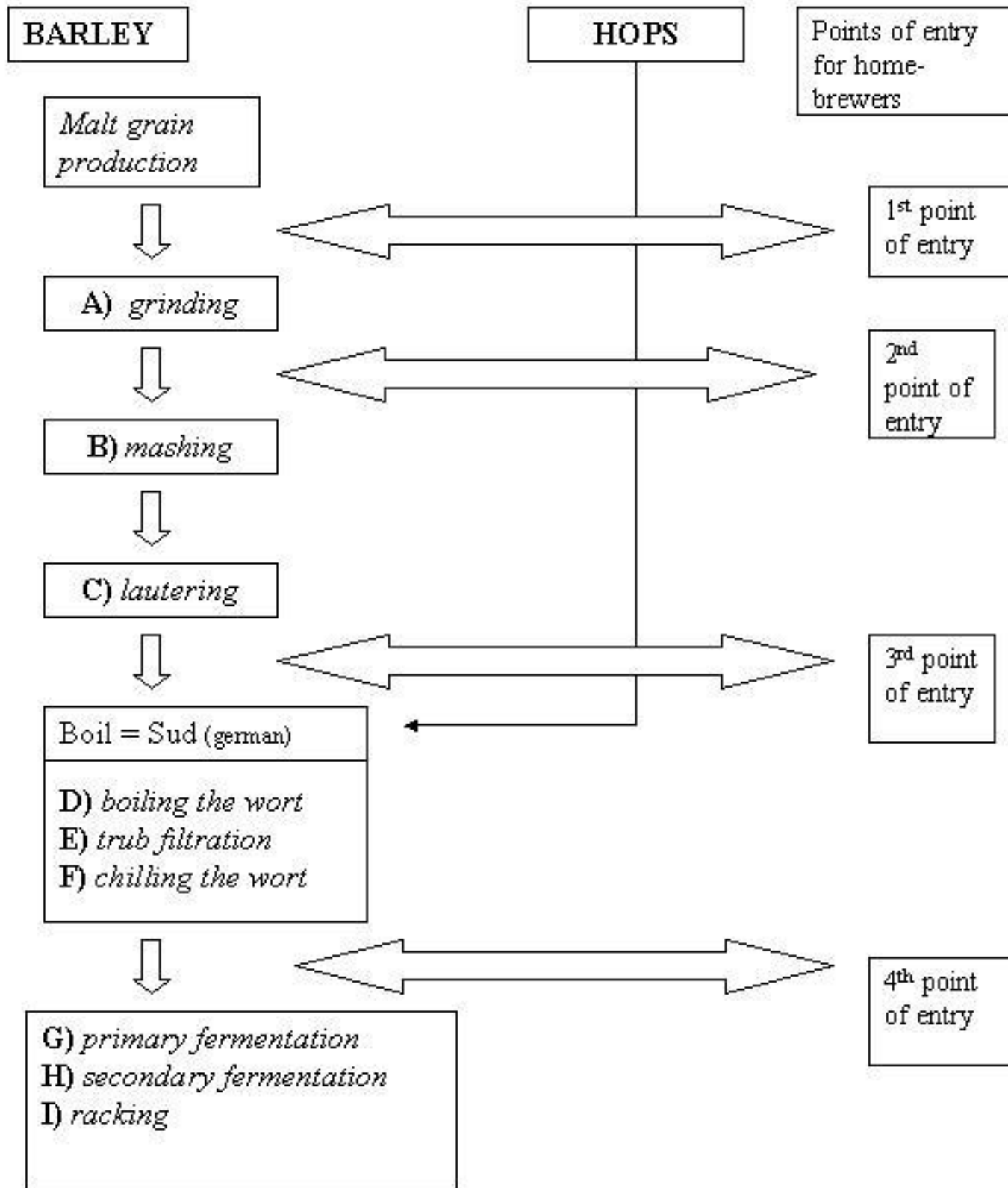
You can download a pdf file (b&w)!!

*Ernst Bratz*

*take always your browser back to the main menu*

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# The steps of beer production



**K) storage**

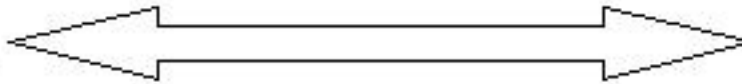


## The steps of beer production

**BARLEY** (brewing-barley grains)

### Malt grain production:

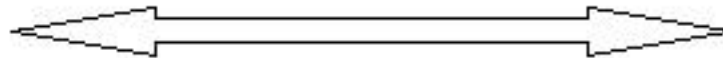
grains are soaked, sprouted, kiln-dried in the 'malt factory'



1<sup>st</sup> point  
of entry  
HB

### A) grinding:

the malt grains are crushed in mills or special machines  
by special malt factories, breweries, homebrewers



2<sup>nd</sup> point  
of entry  
HB

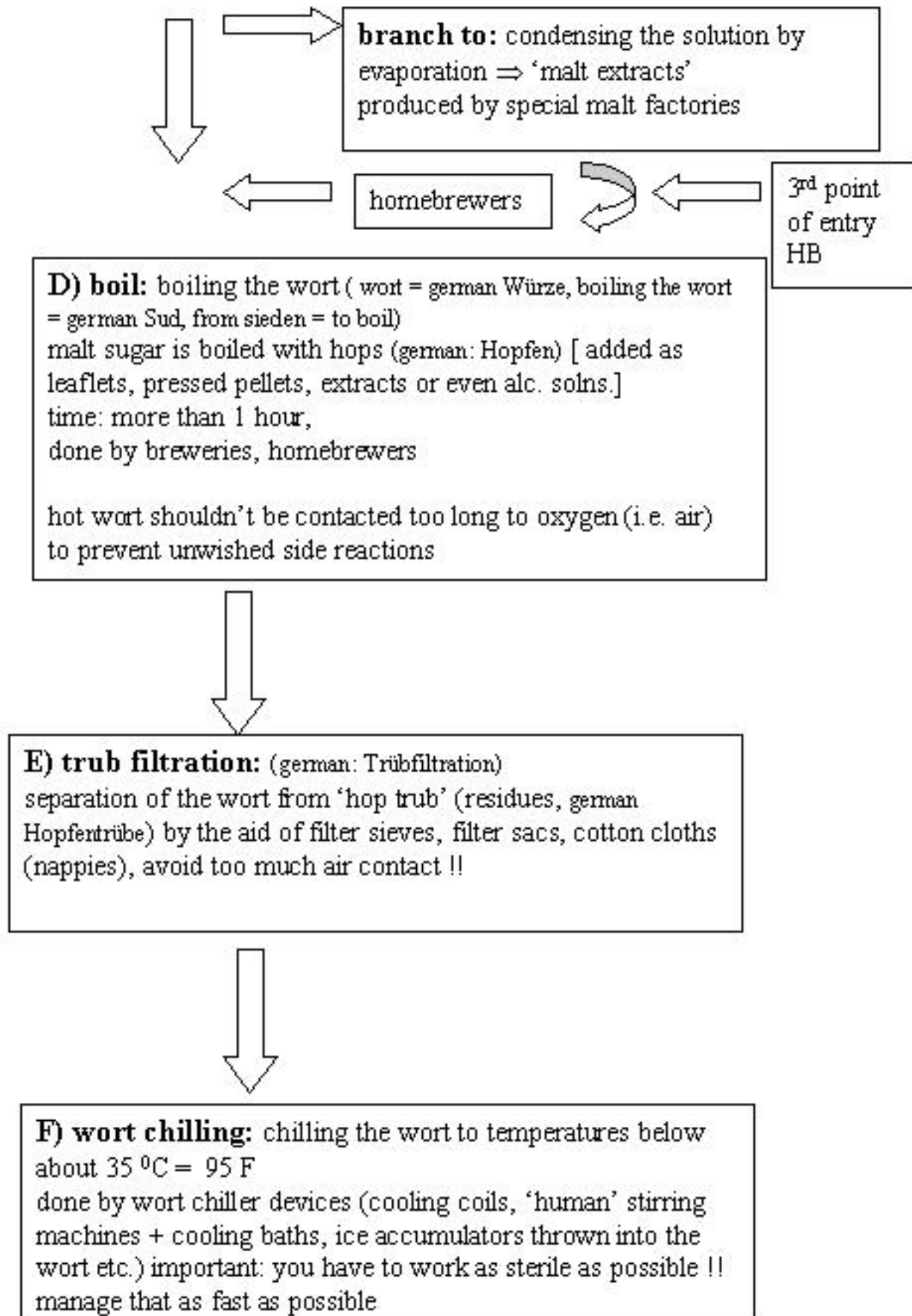
### B) mashing: (german: Maischen)

enzymatic conversion of cereal starch to a sugar mixture  
(mainly malt sugars) [iodine probe on starch conversion]  
bioprocess with controlled temperature steps  
done by special malt factories, breweries, homebrewers  
result: malt sugar solution + grain residues = ***mash***

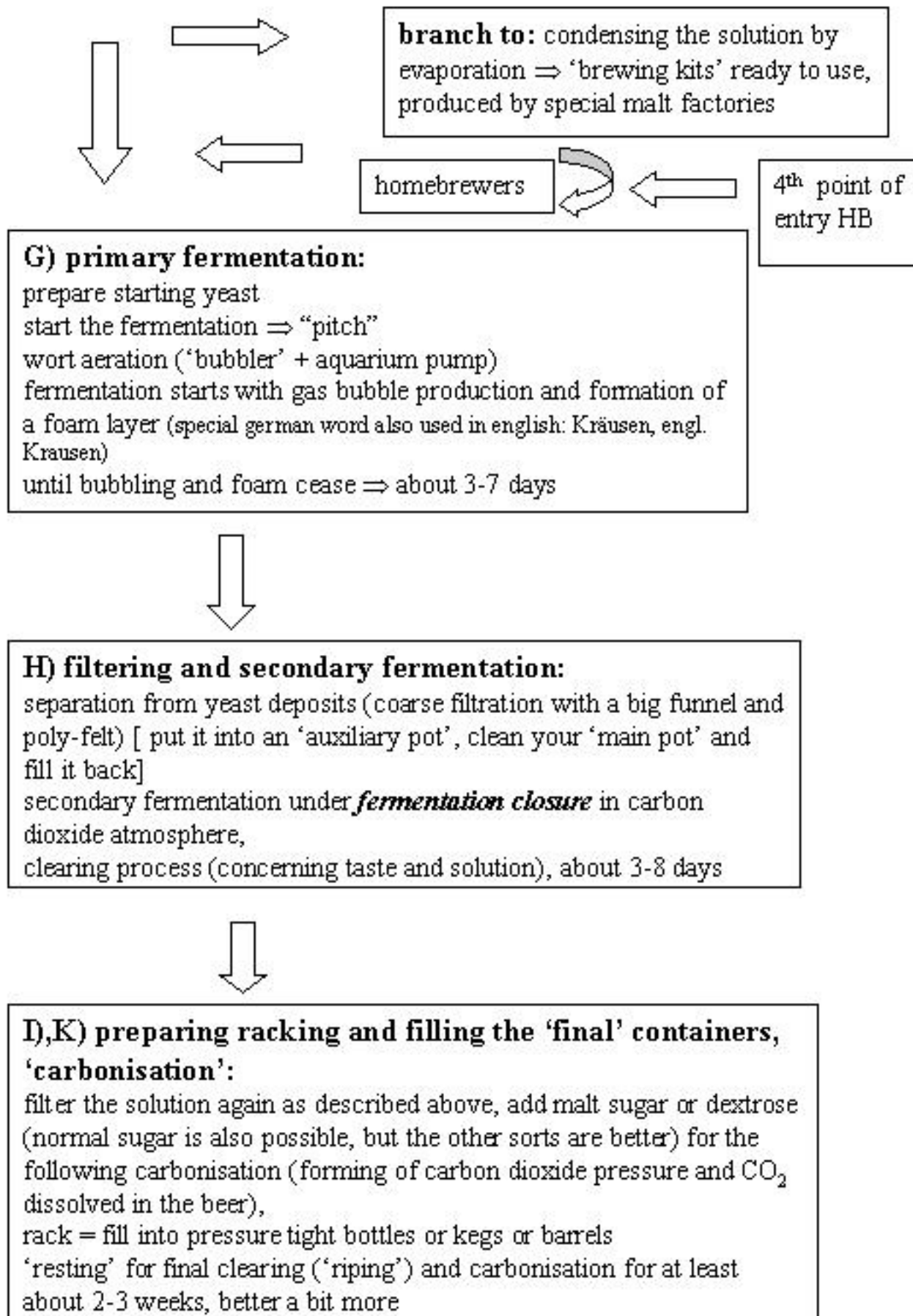
### C) lautering: (german: Läutern)

separation of clear sugar solution from trub (residues, german  
Trübe) i.e. a sort of filtering process (may also be settling  
and decanting  $\Rightarrow$  a tedious work, '*mechanical unit  
operation of process engineering*' )  
done by special malt factories, breweries, homebrewers  
result: 'clear' malt sugar solution









## The steps of beer production

### •From barley to malt sugars:

o barley grains contain:

- starch
- enzymes (protease,  $\alpha$ - and  $\beta$ -amylase)
- o the 'pretreatment' in the malt factories 'activates' the starch/enzyme-system
- o the mashing process:
- starch + enzymes  $\rightarrow$  malt sugars

### •The boil:

o Hops contain:

- bitterness components
- resin components for foam stabilization
- components for natural clearing from hazes, sterilization and removing of strange tastes

o while boiling the wort these components are extracted from the hops and start the various reactions mentioned above.

### •The fermentation:

o Yeast consists of living cells. In the first stage of fermentation under aeration the cells are propagated (bred) under sugar consumption. In this stage they produce alcohol and carbon dioxide. At the end of the primary fermentation the yeast cells 'realize themselves' that the alcohol concentration has reached about 5%. They stop the alcohol production (that would then get more and more dangerous for their own life) and produce only  $\text{CO}_2$ , - this is the stage of the secondary fermentation.

o For beer brewing there exist two fundamental types of yeast:

- The top fermenting yeasts, typically working at  $14 - 18^\circ\text{C}$  ( $57 - 64.5^\circ\text{F}$ ), these yeasts tend to swim on the top of the fermenting liquid, forming a dense foam layer. These yeasts are taken for the production of the beer type collectively called ALES (e.g. German Weißbeer, Alt, Kölsch, all sorts of ales etc.). The elevated temperatures are a bit simpler to handle for the homebrewers. The beers are a bit more tasting for fruits or other flavours, a consequence of the yeast metabolism.

- The bottom fermenting yeasts, typically working at  $6 - 10^\circ\text{C}$  ( $42.8 - 50^\circ\text{F}$ ), these yeasts sink to the bottom in the fermenter, they are taken for the production of beers of the 'LAGER'-type (e.g. Lager, Pils, Export, etc.).

The low temperatures demand a fermentation in an ice box. The beers are very neutral in tastes that are coming from malt, aromatic hop tastes are pronounced.

## •What do you need for the procedures A-H ?

- A): grinding the grains
  - grinding mill: hand driven coffee mill
  - special electrical cereal grain mill
- B): mashing
  - electrically heated (noncorrosive, stainless steel, enamel) pot with (possibly) 2-3 step energy switch, good external temperature controller (simple build in controllers are normally insufficient, as they exhibit a too large hysteresis), good thermometer (mechanical protection for harsh conditions), good spoon for stirring by hand (alternatively electrical stirrer, speed controlled [drilling machine] ), hydrometer for measuring the specific gravity, iodine solution for 'iodine probe on starch', measuring cylinder (plastic or glass) for hydrometer msms.
- C): lautering, trub filtration
  - lautering devices:
    - big plastic funnel with polypropylene felt filter cloth or cotton baby diaper (nappy),
    - big pot with small holes or slots, alternatively big pot for settling and decanting,
    - optional but good: liquid pump (e.g. peristaltic pump: 'hose pump')
- D): boiling the wort
  - same pot as in B) (whole equipment) for cooking the boil, stirrer, thermometer
- E): hot trub filtration
  - nylon net filter sac, big plastic funnel as mentioned above
- F): wort chilling
  - copper tube coil or glass- or ss-tube coil as cooler ( dipped into a bucket with cold water or into the kitchen sink ) or a concentric tube heat exchanger, needs a liquid pump, alternatively you have to produce a pressure drop by height difference (hydrostatic pressure) for managing the flow

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○ **G): primary fermentation**

- 'good' plastic barrel for fermentation (20-30 liter, 5 – 8 US gallons), 'gas tight' with wide top opening, hole for fermentation closure, tap on bottom for racking and emptying, gas inlet for a tube/hose for aeration bubbler
- aeration bubbler, hose connection
- fermentation closure
- aquarium pump (membrane air pump)
- hydrometer + cylinder
- thermometer, spoon

○ **H): secondary fermentation**

- big plastic funnel + filter cloth as mentioned above
- second simple (auxiliary) plastic barrel for 'moving'

Additional equipment:

- measuring beakers (glass or stainless steel)
- kitchen balance
- chlorine solution for sanitizing

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## The steps of beer production

### The single procedures in detail

*Let us start from the last point of entry for homebrewers in our previous text, - that is because the process gets more and more complex when stepping from the rear to the beginning. But that doesn't mean that the last part of the brewing process, the fermentation and carbonisation, is the 'most simple' part. In my opinion represents the fermentation the most important, difficult and sensitive process, - it is decisive for the brewing result.*

#### **•Fermentation:**

When starting with the fermentation process you need the following materials:

- a brewing kit, 'that is': a tin box with a 'complete wort extract' (e.g. Glenbrew German Weizen 3.15 kg = 7 lb. The kit contains also a little package with dry top fermenting yeast, - but I would recommend to buy a special yeast (Wyyeast 'Weihenstephan') to get a better result in flavour.
- 'devices' as mentioned under G) and H)
- you pour the 'extract' into your fermenter (plastic barrel) and dilute it with 'sterile' water - (good fresh water without chlorine, if water contains much chlorine, you should boil it for about 15 min and cool it down to room temperature (less than 20 °C) ) - to a bit less as the end volume. Then you should measure the specific gravity and adapt it by dilution to about 11.5 to 13.5 weight % that is about 1.0115 to 1.0135 g/ml. Here you will realize that a hydrometer with an optional temperature correction is pretty good ! When the directions for use of the kit are correct, the given dilution and the reached gravity should be in conformity.
- then you prepare the yeast starting procedure following the given directions of the producer (Wyyeast e.g. is delivered in Aluminium bags and you have to press on it to open an internal bag for the starting procedure (and that some time before!!), - after this the outer bag begins slowly to swell)
- then you have to "pitch", that is to pour the started yeast culture into your fermentation 'broth'. Stir for a few minutes.
- put the aeration bubbler into the fermenter and switch your aquarium pump on, close the fermenter
- when you use a bottom fermenting yeast, you have to put your fermenter into an ice box with 8-10 ° C (44-50 F). A fermentation with top fermenting yeast should be kept at room temperature (but not over 20 °C [68 F])

- 'aerate' in intermitting times for half to one an hour
- after (at least) one day you should observe 'Kräusen', - from this time you should stop with strong aeration (at least for short instances only)
- Now you have to wait (up to 7 days top fermenting, 9-12 days bottom fermenting). When the fermentation gets slower and slower, you should measure the gravity. If you have reached values below 5 weight % (1.005) you can think about stepping to the second fermentation, - but you should have spent at least about 4-5 days (top fermenting, 7-9 days bottom fermenting).
- pour your (now for the first time:) *beer* via the big filtration funnel into your auxiliary pot. Clean your fermenter thoroughly. Fill the beer back to the fermenter. Close the pot by a fermentation closure (carbon dioxide can 'bubble out', rest is gas tight, no oxygen gets in).
- wait for 3-7 days (top fermenting, 4-8 days and more bottom fermenting). The beer should be visibly clear (when settled yeast is not raised by agitation).
- repeat the decanting process to remove the settled yeast (decanting and filtration to the auxiliary pot and so on).
- put the clear beer again into the clean fermenter. Add dry malt sugar or dextrose or normal sugar with a spoon. Take about 30 gr for 10 liters.
- stir the solution, close the fermenter and wait up to one day (top fermenting, 2-3 days bottom fermenting) and then fill your gas tight sterile bottles or your barrel and close it perfectly.
- store the beer for about one week at room temperature (top fermenting, bottom fermenting at 10 °C in the ice box). Put the vessels into the ice box and cool down steadily to about 4 °C over several weeks, but now try it from time to time.

### • **'Cooking' the boil:** (one step before!)

When starting with the boil you need the following materials:

- malt extract from your supplier or malt solution coming from a previous *mash*. Dilute the extract following the instructions of the supplier.
- hops as pellets, leaflets or extract (about 100 gr pellets or leaflets for about 20-30 l (5-8 US gallons) ). The usual quantities of extract are sufficient for 3-4 batches, look to the instructions given by the supplier.
- as equipment you need the objects listed in D) to F)
- you heat your malt solution to the boiling point, then you add cautiously 2/3 of the hops ( about 1.5 to 2 g per liter wort ; - attention, tends to foaming) and boil it for one hour, - then add the rest (about 0.5 to 1 gr per liter wort) and boil further 20 minutes
- pour the hot, not boiling mixture in a big funnel with a plastic nylon net or a cotton cloth inside (hot trub filtration), avoid too long contact to the air !



➤ cool down the wort to 35 °C (95 F) as fast as possible and with minimum contact to air ( let it flow through a cooler coil that is within a bucket with flowing cold water, - you may need a peristaltic pump! Or throw ice box accumulators into the wort in a pot – but be cautious, 'stay sterile'. When you do it slowly by putting your pot into cold water and moving it, you should close your pot thoroughly and produce no big area for 'gas-exchange' by vigorous agitation, producing foam and bubbles.

➤ always pay attention that you get no fruit flies or other creatures into your wort, they 'import' dangerous microbes, which 'overbreed' and kill your yeast cells later on and your fermentation will end in a vinegar or lactic acid production or some stinking broth !!! always work clean ! sometimes microbes are also imported by air conditioning devices via the surrounding air !

➤ continue with the fermentation as described above !!!

### ● **mashing:** (two steps before fermentation)

When starting with mashing, you need the following materials:

➤ (coarsely) ground malt grains, - when taking mixtures, as for instance for german Weizen, the amount of barley has to be sufficient because barley contains more enzymes than the other cereals. Take mixtures recommended by the supplier or get some advise. The grains should not be ground too fine as you get starch glue in this case and your mash gets a pap and is difficult to stir and filter (lautering) !!

➤ iodine solution for the iodine probe

➤ as equipment you need the objects listed in B) and C)

➤ put your ground malt grain into the 4fold quantity of tap warm water, stir and heat to 35 °C, wait for 5-7 minutes at 35 °C, then heat under stirring to 55 °C with about 1 °C per minute, wait for 10 minutes when 55 °C have been reached (german: Eiweißrast = resting for protease activation). Then heat to 65 °C with about 1 °C per minute, rest at 65 °C for 30 minutes ( german: Verzuckerungsrast = resting for the first sugar formation reaction )

➤ try the first iodine probe: take less than half a teaspoon of the mash liquid mixture (suspension without too much 'grainy' residues, but not totally clear), put it on a white coffee saucer, add some drops of iodine solution. When the mash contains not-converted starch the whole test spot gets dark blue, - when it gets light brown, the conversion has already nearly completed. Normally this first probe is positive on starch (dark blue).

➤ continue heating to 72 °C , again with 1 °C per minute, and rest at 72 °C for 30 minutes (german: Endverzuckerungsrast = resting for waiting for the total conversion of starch to sugar.

➤ continue with the second iodine probe as described above. This probe should be negative on starch now. When not, wait further 10 minutes. When 'yes' heat up to 78 °C and rest at that temperature for 30 minutes, (german: Endrast = final waiting )

➤ now follows the lautering process:



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First let your mash settle down a bit, then try to decant it and pour the decanted liquid through a big funnel with a cloth filter. Put the rest of the mixture in portions into the 'cloth-sac' in the funnel and press the liquid out gently (not too strong). You can rinse the filter cake with a bit warm water for purging. When your sugar solution is too hazy, you should perhaps repeat the filtering procedure with a 'sharper' filter cloth (with 'more dense' meshes) afterwards. There are alternative lautering operations, like the application of some filtering chandles directly into the mash pot and removing the liquid by suction, the mash forms some sort of filtering cake for it's own filtration. You can think about and try every procedure that you find promising, - make your own experiences. You can also find a lot of proposals in the Internet.