PREPARING SPECIALITY MALTS AT HOME

1. INTRODUCTION

Speciality malts are derived from malted barley that were heat-treated to impart specific flavours, aromas, and colours to the malt and subsequent beer. Unlike base malts, which provide the primary fermentable sugars and structure, speciality malts are used in smaller quantities to add complexity and depth to beer.

Although South African homebrewers are spoiled for choice as far as the availability of speciality malts is concerned, preparing your own can add unique characteristics to your beer, help you in a pinch, allow you to experiment or brew a 100% SA beer, and of course add to the fun of brewing! Unfortunately, numerous variables, such as temperature (incl. gradients), time, amounts, and moisture content, can significantly influence the final flavour, colour, and aroma of the resulting malt. You will therefore have to establish an exact protocol for each speciality malt in your baking/roasting system through empirical experimentation and repetition.

This document –

(i) presents background information on speciality malts, their preparation, and uses to guide your selection and approach to preparing your own speciality malts (Section 2),
(ii) summarises the recommendations of other home roasters (Section 3), and
(iii) guides your efforts based on our own experiments using locally relevant products (Sections 4 & 5).

2. SPECIALITY MALT BACKGROUND INFORMATION

Some common types of speciality malts are:

- **Crystal malts:** Wet malts (usually green malt coming directly from the malting process) are heated in a controlled environment to caramelize the sugars and then kilned (baked more than roasted) at medium temperatures to produce a range of colours from golden to dark brown. They add body, sweetness, caramel-like, and sometimes dried-fruit flavours to beer.
- **Roasted malts**: Green malt is first dried and then heated to high temperatures (roasted), resulting in dark colours, rich flavours, and often a slightly bitter or burnt taste.

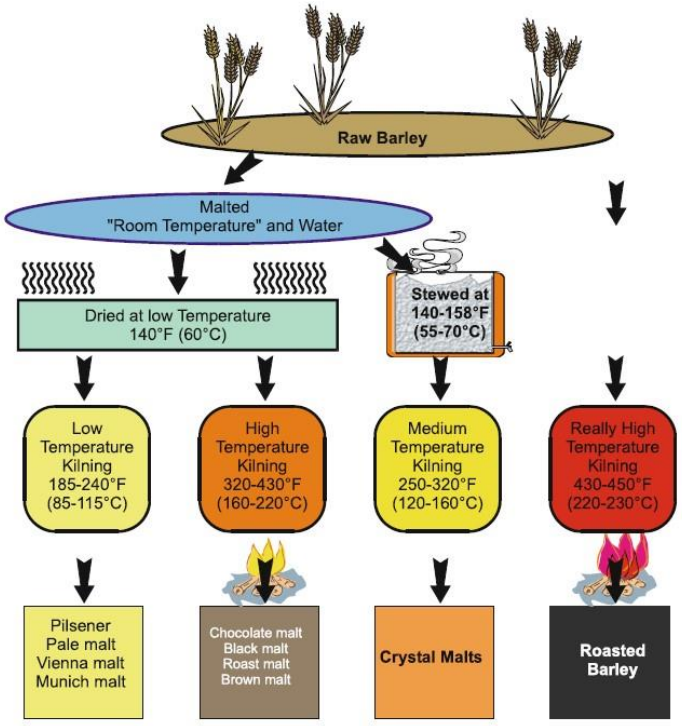

Figure 1. Overview of the preparation protocols for various barley malt varieties (M Mosher & K Trantham, 2021).

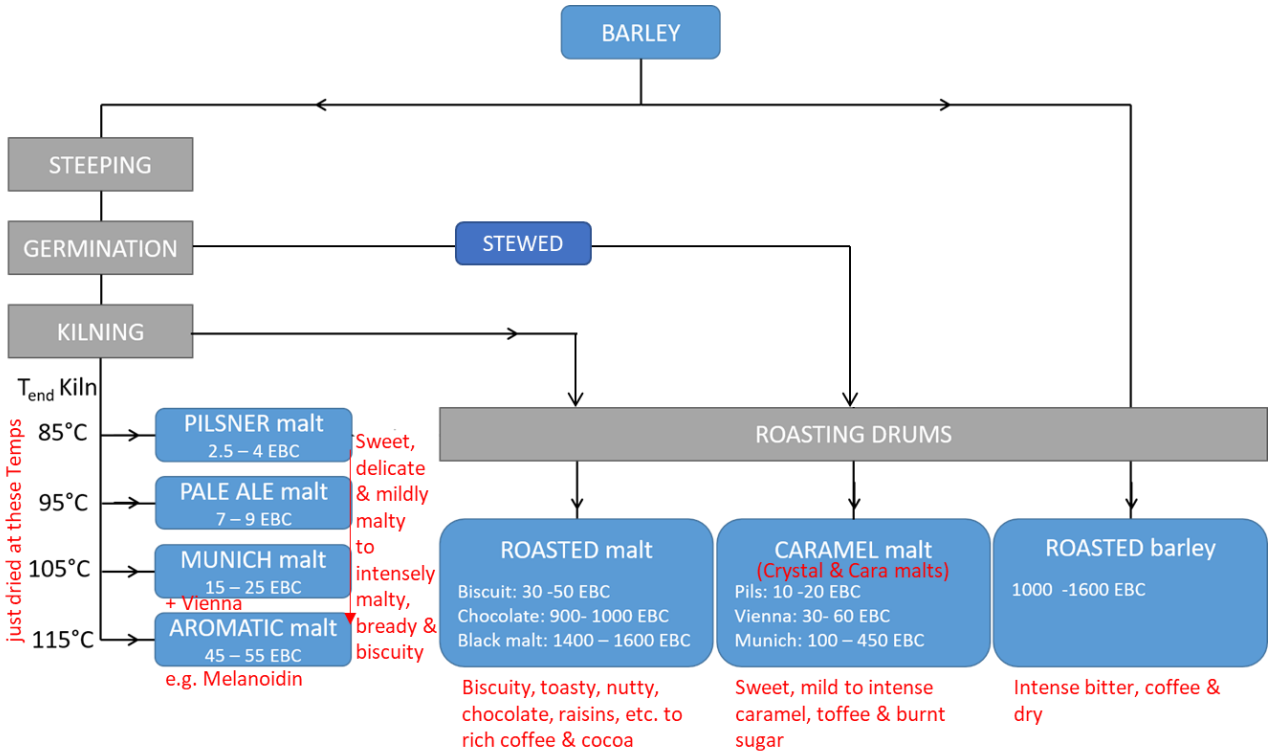

Figure 2. Preparation protocols and flavour profiles for various barley malt varieties (adapted from Wageningen EdX course, ‘“The Science of Beer”).

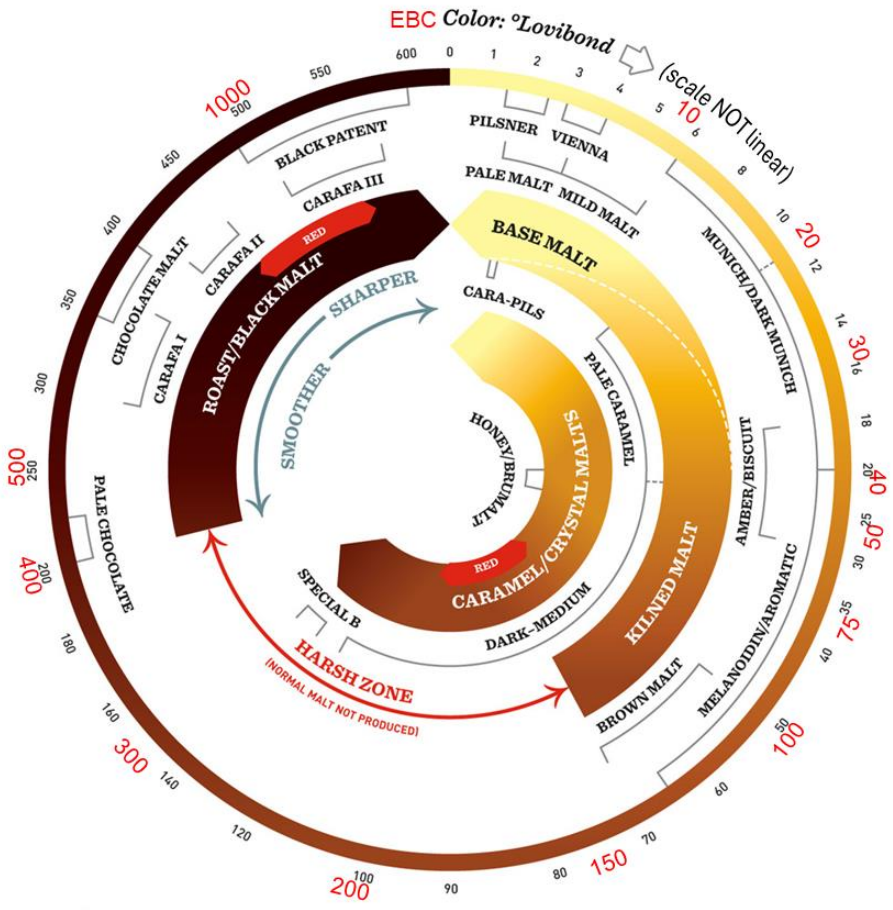

Figure 3. Malt colour wheel that categorises different malt types according to their colour and approximate kilning temperature. Note the “harsh zone” between ~150 and 400 EBC – it is recommended that you only home roast malts <150 EBC. Adapted from “Mastering Homebrew”, R Mosher.

Overview of the different barley malt varieties' colour, flavour, and use suggestions from two different sources.

Malt Types					
Malt types	**Examples**	**Qualities**	**Beer styles**	**Amount in 5 gallons**	**Lovibond (degrees)**
Base	ale, lager, pilsner, and Munich malts	body, flavor	all	7 to 20 pounds	Munich: 5°-35° 12 - 92 EBC
Caramel	dextrin, carastan cara-pils, cara-Vienne, cara-Munich, Special B, and crystal malts, cara-wheat	sweetness, mouthfeel, color, foam stability	very pale beers, wheat beers, German lagers	1 to 10 pounds	Lightest: 1.5°-17°; can be as dark as 135°-165°, up to 250° for Special B 2.5 - 700 EBC
Roasted	biscuit, British amber, brown, chocolate, black, carafa, and Kilncoffee malts	can define beer style; deepen the beer color; from toasted to burnt flavor	brown ales, porters, dark beers	2 to 8 ounces	23°-26° biscuit 50°-70° amber/brown 325°-500° chocolate 500°-600° black 60 - 1600 EBC
Other:	roasted barley: honey malt: rauchmalt:	burnt flavor sweet notes smokey flavors	stouts pale beers smoked beers	2 to 8 ounces 1 to 20 pounds varies	varies 25° to 30° varies

From: https://byo.com/article/malt-madness-specialty-grains/

Product Type	Color Range (EBC units)	Moisture (%)	Descriptive
Roasted barley product	1440–1800	<3.5	Astringent, burnt, smoky
Pale malt products			
Amber malt	48–96	<3.5	Dry, baked
Chocolate malt	1200–1440	<3.0	Mocha, treacle, chocolate
Black malt	1440–1680	<3.0	Smoky, coffee
Green malt products			
Cara malt	25–40	<7.5	Sweet, caramel
Crystal malt	90–360	~3.5	Malty, caramel, toffee-like
Dark crystal malt	120–150	<3.5	Burnt toffee, caramel
Caramel malt	260.320	<3.5	Burnt toffee, caramel
Colored kilned malts			
Munich malt	10–15	~3.8	Grainy, malty (marked)
Vienna malt	7–10	~4.5	Grainy, malty (subtle)

From: https://doi.org/10.1201/b15246-4

3. WHAT OTHER HOME ROASTERS HAVE DONE

3.1. Basic principles

Note: The terms used to describe the kilning/baking/roasting of malts, as well as the resulting product categories, e.g. base, crystal/caramel, toast, and roast, are not well-standardised, particularly when considering literature from different parts of the world. Some terms used here may therefore not align with your own understanding, however, we recommend you rather focus on the general principles than get caught up in less important details.

(i) As presented in Fig 1 & 2, as a rule, the production of speciality malts directly follows the malting process. While crystal malts are prepared directly from the wet green malt, the green malt is first dried and then roasted to produce roasted malts. Although the same approach can be followed at home if you malt your own grains, here we will only focus on starting with a dry, commercial base malt, i.e. SAB Pale Malt.

(ii) The moisture content of the grains being baked/roasted significantly influences the processes and resulting products. It is therefore the basis on which three main approaches to home roasting can be distinguished (Fig 4).

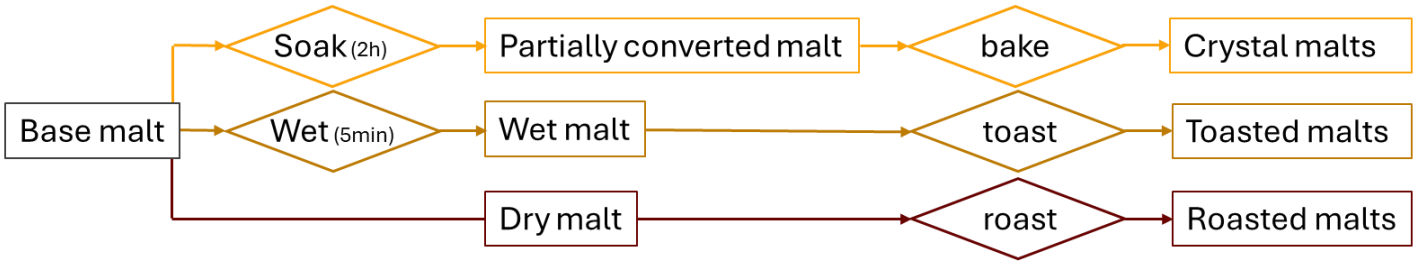

Figure 4. Overview of the three different

(iii) **Soaking and baking** produce **CRYSTAL/CARAMEL** – malts with richer, maltier, sweet caramel-like flavours. Crystal malts are usually prepared from green malt (still wet, just after the malting process), however, you can also rehydrate a base malt to get similar results. A longer, e.g. 2h, hydration step at ~65°C is like a mini-mash that produces sugars that can participate in various chemical reactions (see vi below) during the subsequent roasting step.

(iv) **Wetting and toasting** produce **TOASTED MALTS** – malts with biscuity/cracker aromas and flavours.

(v) **Dry-roasting** produces **ROASTED MALTS** – malts with drier, sharper, roasty flavours and little underlying sweetness.

(vi) Relevant chemical reactions/conversions during the heating process include -

- Maillard reaction (140-165°C), reactions between sugars and amino acids to produce a complex array of melanoidins and other flavour compounds. Moisture and high pH values enhance the Maillard reaction.
- Caramelisation (150-180°C), sugars like glu, suc & maltose lose water and polymerise at high temperatures and in doing so, change their colour and flavour.
- Pyrolisis (>250°C), decomposition of organic material to eventually leave only carbon.

(vii) Toast by **aroma**, not by colour. Malt brews a darker beer than what it looks like. For example, if you cut it open and look inside, brown malt is barely a pinkish copper colour, not brown.

(viii) As a rule of thumb, bake/roast malts at temperatures ranging from 70°C to 200°C and 15 to 60min. The higher the temperature and longer the time, the darker the toast/roast.

(ix) **Roasted malt needs to cure before using**. The kilning process creates harsh, volatile chemicals that will give your beer an ashtray aroma if you don't give them time to dissipate. Two weeks in a paper bag should be adequate to get rid of these.

3.2. Baking/roasting parameter guidelines from other sources

Reference 1 - https://www.brewcabin.com/roasted-malt/

CRYSTAL MALT ROASTING GUIDELINES[1]			
Time (min)	**Temp (°C)**	**Colour**	**Flavours**
20	120	Pale gold (10L, 25 EBC)	Nutty, not toasty
25	150	Gold (20L, 52 EBC)	Malty, caramelly, rich, not toasty
30	180	Amber (35L, 92 EBC)	Nutty, malty, lightly toasty
40	190	Deep amber (65L, 172 EBC)	Nutty, toffee-like, crisp toastiness
30	200	Copper (100L, 265 EBC)	Strong toasted, some nuttiness
40	200	Deep copper (125L, 332 EBC)	Roasted, not toasted, porter-like, chocolate to coffee
50	200	Brown (175L, 465 EBC)	Strong roasted flavours, coffee

[1]From https://www.brewcabin.com/roasted-malt/

Reference 2 - PhD thesis "Control of Malt Roasting Operations 2020"

Table 1.1: A typical range of commercial roasted products based on barley.

Malt Type	Roasting Substrate	Finishing Temperature (° C)	Colour (° EBC)	Maximum Moisture (% w/w)
Amber Malt	Pale Malt	100 – 150	45 – 85	<3.5 – 4.0
Caramalt	Green Malt	-	30	3.0 – 7.5
Light Crystal Malt	Green Malt	-	90 – 140	6.0
Medium Crystal Malt	Green Malt	-	160	5.5
Dark Crystal Malt	Green Malt	-	200	5.0
Chocolate Malt	Pale Malt	225	1200	3.5
Black Malt	Pale Malt	230	1450	3.5
Roasted Barley	Unmalted Barley	230	1500 – 1700	<2.0 – 3.5

(Briggs, 1998b, Boortmalt, 2010j, Blenkinsop, 1991)

Roasting parameters (isothermal in each case) for the roasting substrates were selected as follows:

- Pale malt and raw barley: (to produce toasted and roasted malts)
  - Time: 10 min - 30 min
  - Temperature: 100 °C - 230 °C
- Green malt: (to produce crystal malts)
  - Time: 20 min - 50 min
  - Temperature: 135 °C - 165 °C

  Green malt was first 'stewed' in a sealed glass bottle at 65 °C for 1 hour in a laboratory oven.

Reference 3 - https://www.brewersfriend.com/forum/threads/roast-your-own.3720/

- **Gold Malt** (est. 20 L) that is malty, caramelly and rich but not toasty roast your base malt for 25 minutes at 150°C.
- **For Amber Malt** (est. 35 L) that is Nutty, Malty, and lightly toasty roast your base malt for 30 minutes at 180°C.
- **For Copper Malt** (est. 100 L) that has a strong toasted flavour with some nutlike notes roast your base malt for 30 minutes at 200°CF.
- **For Brown Malt** (est. 175 L) that has a strong roasted flavour, roast your base malt for 50 minutes at 200°C.
- **For Chocolate Malt** (est 200+ L depending on time and heat): You need more heat and control than what you can get in the oven. For Chocolate malt use a clean stainless steel or cast iron fry pan on low heat, slowly bringing medium-high heat. You need to stir or shake the pan constantly and not let any kernels sit still or you will end up with scorching instead of dry roasting.
- **For Crystal/Caramel Malt** soak 1-2 lbs of pale 2 row in just enough water to cover plus about an inch (make sure you use distilled, filtered tap, or spring water). Let soak for a few hours, but no less than 2 hours and no more than 24, I soak for 3-4 hours. Then Put grains into a pan and keep grains about 2" deep then place into a preheated 85°C oven (make sure you have a probe thermometer in the oven and not to let the temps inside the stewing grain to go above 70°C. If they do reduce your ovens temperature) for 1 ½ hours. Then spread out grain into 2 separate pans and make sure the grains are no more than 1" deep. Then increase temperature in over to 120oC and let bake for 2 hours or until dry. Then if desired remove from oven for light crystal, or use the roasting guide above to create your own darker versions of crystal malt.

4. ROAST YOUR OWN MALT

Note: I started using an electric oven to roast malt but then discovered the rotisserie basket of the air fryer, which gives a more even roast with less hassle. I describe both here but recommend the rotisserie. The only drawback of the rotisserie is that you can do only 500-600g per batch.

4.1. Basic OVEN protocol to prepare CRYSTAL malts at home

1. Weigh off 500g uncrushed SAB pale malt.
2. Heat 500ml water (100% of grain) to 70°C in an appropriately sized pot then turn off the stove.
3. Add the grains to the water and soak for 120 min. Slowly reheat the mini-mash again after the first 60 min to 65°C while stirring.
4. Preheat oven to the desired temp (see Section 2 for general guidance & the empirical data in Section 5). Use the oven fan, if available, to ensure more even heat distribution.
5. Pour off possible excess water and then spread the wet grain in a thin layer (≤10mm) on a large (350 x 640mm) baking tray and bake for the desired time and temperature. Stir the grain regularly (every 10-15min) to ensure an even roast.
6. Remove from oven to cool down – stir around to facilitate quick cooling.
7. Dry completely at a low temp (~50°C) if required (a short roast may not dry the grain completely).
8. Rest in a paper bag or open container for a week or two until the harsh aromas have disappeared (more relevant for darker roasts).

Note: When you have standardised your roasting parameters for a specific amount of grain, temperature, and time in your oven, you can't just increase the amount of grain and expect the same result.

4.2. Basic AIR FRYER with ROTISSERIE protocol to prepare TOASTED malts at home

1. Weigh off 600g uncrushed SAB pale malt.
2. Add 200ml water and stir for 5 min to thoroughly wet all the grain. It should absorb all the water.
3. Transfer the grain to the rotisserie basket and bake for the desired time and temperature with the rotisserie on.
4. Remove from the air fryer and pour the grain out on a large sheet to cool down – stir around to facilitate quick cooling.
5. Dry completely at a low temp (~50°C) if required (a short roast may not dry the grain completely).
6. Rest in a paper bag or open container for a week or two until the harsh aromas have disappeared (more relevant for darker roasts).

Note: Combine the soaking step described in 4.1 with this baking protocol to prepare CRYSTAL malts or dry-roast for ROASTED malts.

4.3. Basic PAN ROASTING protocol to prepare DARK ROASTED malts at home

1. Weigh off 600g uncrushed SAB pale malt.
2. Transfer the grain to a thick-bottom frying pan and roast on medium heat until desired aroma/colour.
   IMPORTANT – the grain must be stirred constantly to prevent burning and ensure an even roast. Adjust the heat if roasting seems too slow or quick.
3. Pour the grain out on a large sheet to cool down – stir around to facilitate quick cooling.
4. Rest in a paper bag or open container for a week or two until the harsh aromas have disappeared (important for these darker roasts).

Notes:
- *Lower temperatures will increase the roasting time, while higher temperatures will yield uneven results and may scorch some grains.*
- *Although it is highly variable, a 30 min roast should yield a dark (~400 EBC) roast – quicker than oven or .*

5. EMPIRICAL ROASTING EXPERIMENTS & OUTCOMES

EMPIRICAL CRYSTAL MALT ROASTING PARAMETERS						
Time (min)	**Temp (°C)**	**Colour**	**Malt flavours & aromas**	**Extract flavours & aromas (10g/50ml)**	**Similar to**	**Own descriptive malt name**
ELECTRIC OVEN & STOVE-TOP						
0	0	4 EBC	Raw grain, endosperm	Raw grain	**SAB Pale** (base used for all experiments)	
Experiment 1: Single temp & time, see **Fig 5**						
30	120	~5 EBC (10 L) Husk slightly more golden but endosperm not visibly different from the original.	Sweet, richer maltiness, little nutty	Richer maltiness, less grainy	Between Carapils & Munich	HG Base Nutty 5
Experiment 2: Different times at 160°C, see **Fig 6**						
20	160	~7 EBC (3 L)	Sweet, full-round/rich malty (Horlicks) (still wet when tasted)	1st two just creamy maltiness, same as what you'd expect to get during mashing. Generally, the extracts have cleaner caramel flavours than SAB pale malt itself.	Carapils	
30	160	~10 EBC (4 L)	Sweet, full-round malty, little nutty (still bit wet when tasted)		Munich (with less colour)	
40	160	~20 EBC (8 L)	Sweet, nutty, light biscuit	1st creamy caramel flavours	Biscuit	HG Crystal Caramel 20
50	160	~40 EBC (16 L)	Sweet, crisp cracker, sweet biscuit, little caramel toffee – similar to tamaletjie but not as strong	Stronger darker caramel / tamaletjie flavours	Carabelge	HG Crystal Toffee 40
60	160	~100 EBC (38 L)	Less sweetness, rusk crust or dark toast, but with little bitterness	Dark, hard caramel brittle and some bitterness	? Caramel & roast combined	HG Crystal Brulee 100
Experiment 3: Pan-roasting on a gas stove based on Ref 3 above, see **Fig 7**						
~30	Gas flame	~400 EBC	Nutty roastiness,	Less bitter than choc malt. Colour far from choc malt's.	Choc malt	HG Roast Choc 400

AIR FRYER WITH MESH ROTISSERIE						
Time (min)	**Temp (°C)**	**Colour**	**Malt flavours & aromas**	**Extract flavours & aromas (10g/50ml)**	**Similar to**	**Own malt name**
Experiment 4: Air fryer first tests, see **Fig 8**						
50	180	~65 EBC	Tastes almost exactly like Château Biscuit malt. Taste - dry cracker with a little toastiness. Aroma – sweet, fruity caramel. Fruitiness is "brighter" than that of melanoidin malt.	Sweet & biscuity	Biscuit malt	HG Biscuit 65
30	240	~260 EBC	Taste – first toasty nuttiness then a bit of burnt popcorn. Aroma – roasty.	Roasty & somewhat bitter	?	HG Amber 260
		Will update as I do more experiments				

General notes:

- In my experience, crystal malts prepared from a base malt develop caramel and toasty aromas and flavours, however, they lack the deep fruitiness present in comparable commercial crystal malts.
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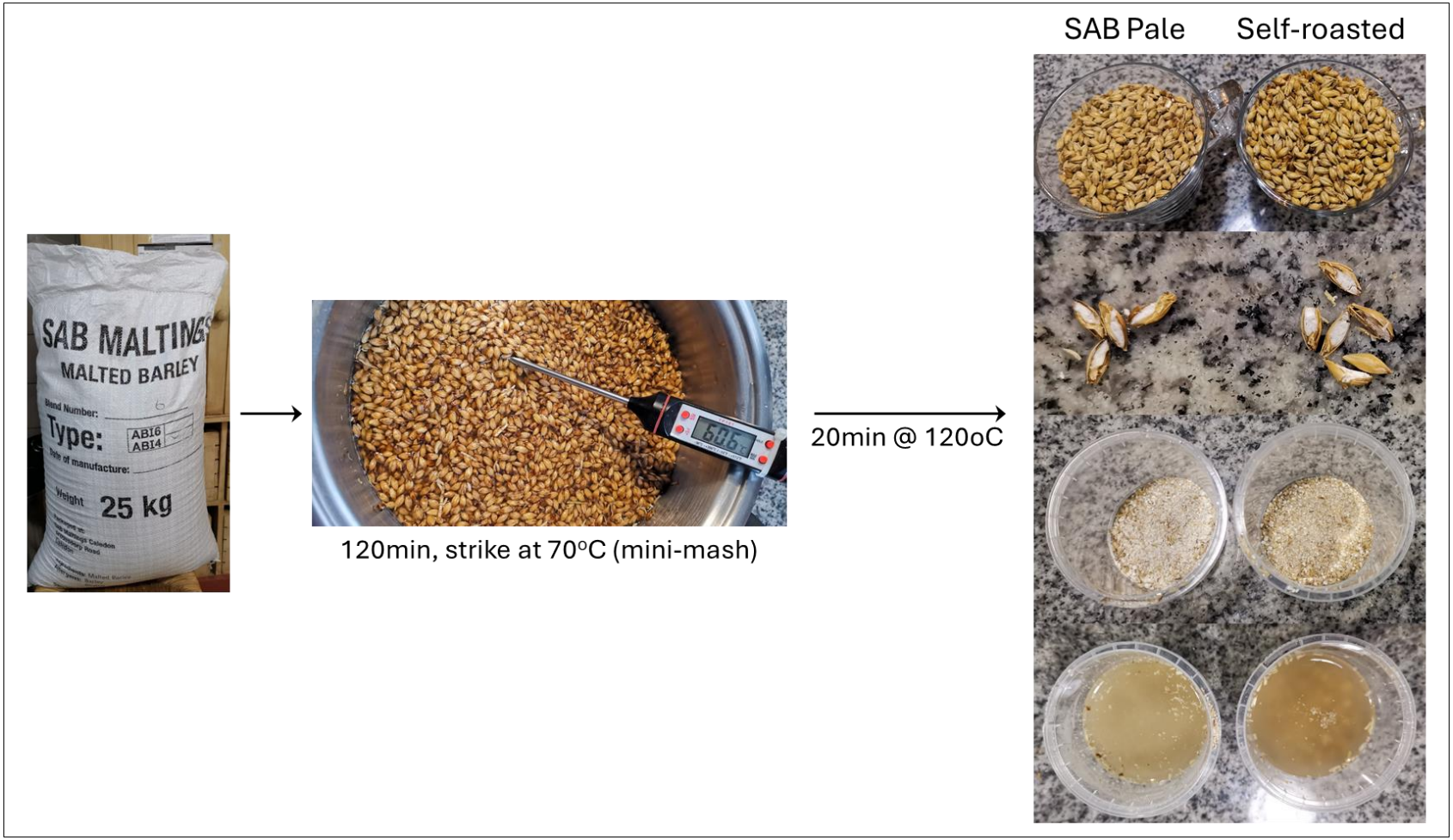

Figure 5. First oven roast to develop a reference point – **Experiment 1**. SAB pale malt soaked and then baked at 120°C for 20min. Little visible impact on the grain but extracted slightly darker and had a richer malty taste.

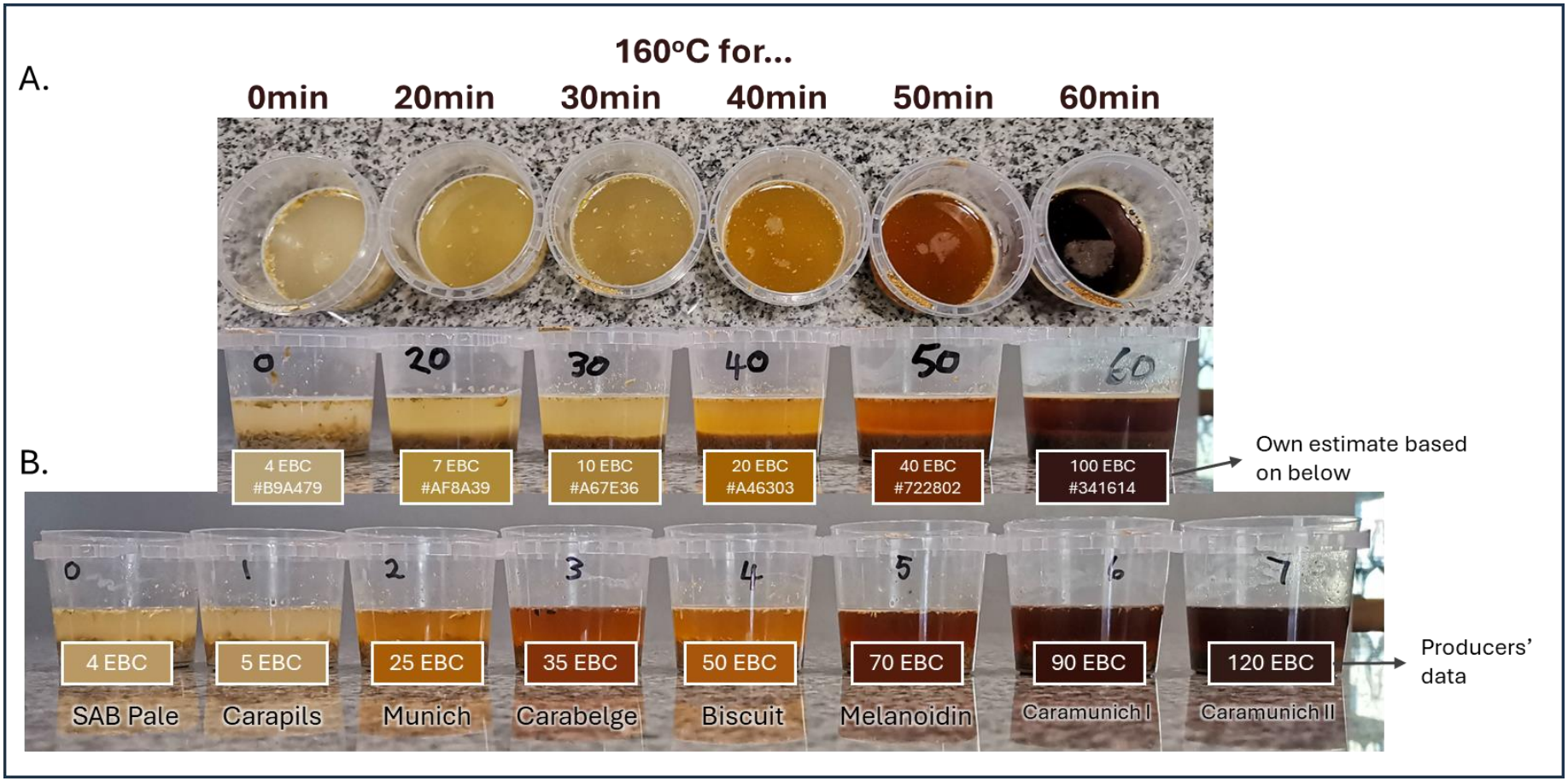

Figure 6. Colour range for self-roasted crystal malts obtained for **Experiment 2**. (A) 500g grain baked at 160°C and samples removed at indicated time intervals. Extracts prepared from 10g milled grain in 50ml water at 50°C. (B) Standard colour range prepared for commercial malts.

Note: The obvious inconsistency between the supposed 35 EBC Carabelge (Weyermann) and 50 EBC Biscuit (Chateau) malts illustrates the inherent variability and imprecision of speciality malt colours.

Figure 7. Comparing malt colours FOR **Experiment 3**. (A) Simpson's Chocolate vs SAB Pale malt. (B) Same chocolate malt in small container vs 30min pan-roasted SAB Pale malt (HG Chocolate malt).

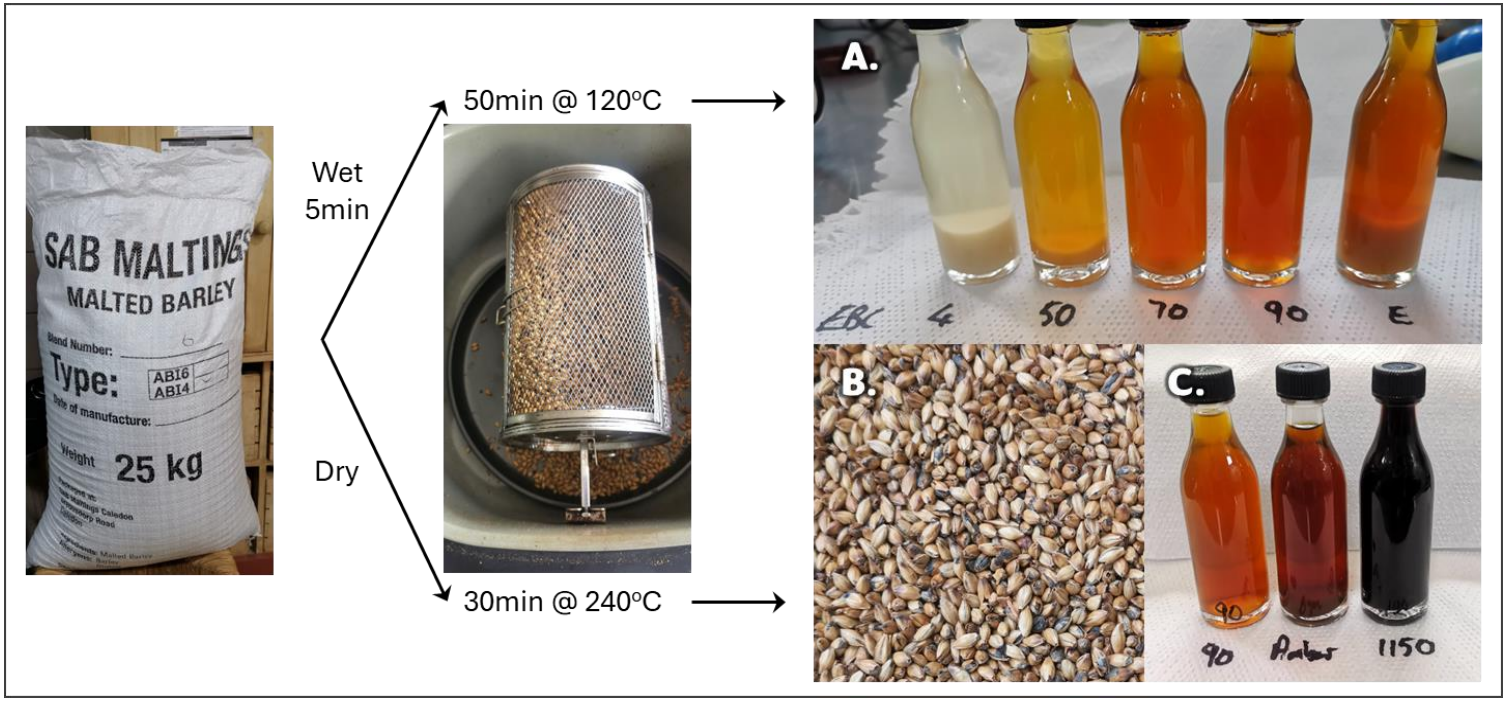

Figure 8. Two speciality malts prepared in air fryer rotisserie – **Experiment 4**. (A) Standard colour range (see below) and HG Biscuit 65 malt in E. (B) HG Amber 260 malt and (C) extract with standards. Note big sediments in SAB malts (4 & E).

EBC	Malt
4	SAB Pale
50	Chateau Biscuit
70	Caraamber
90	Caramunich I
1150	Simpson's Chocolate