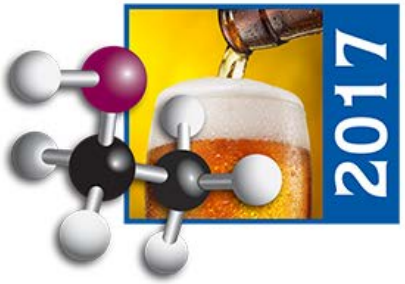


ASBC Annual Meeting

June 4–7 ■ Fort Myers, Florida

See what SCIENCE can brew for you

Barley Malt: The Foundation of Beer Flavor

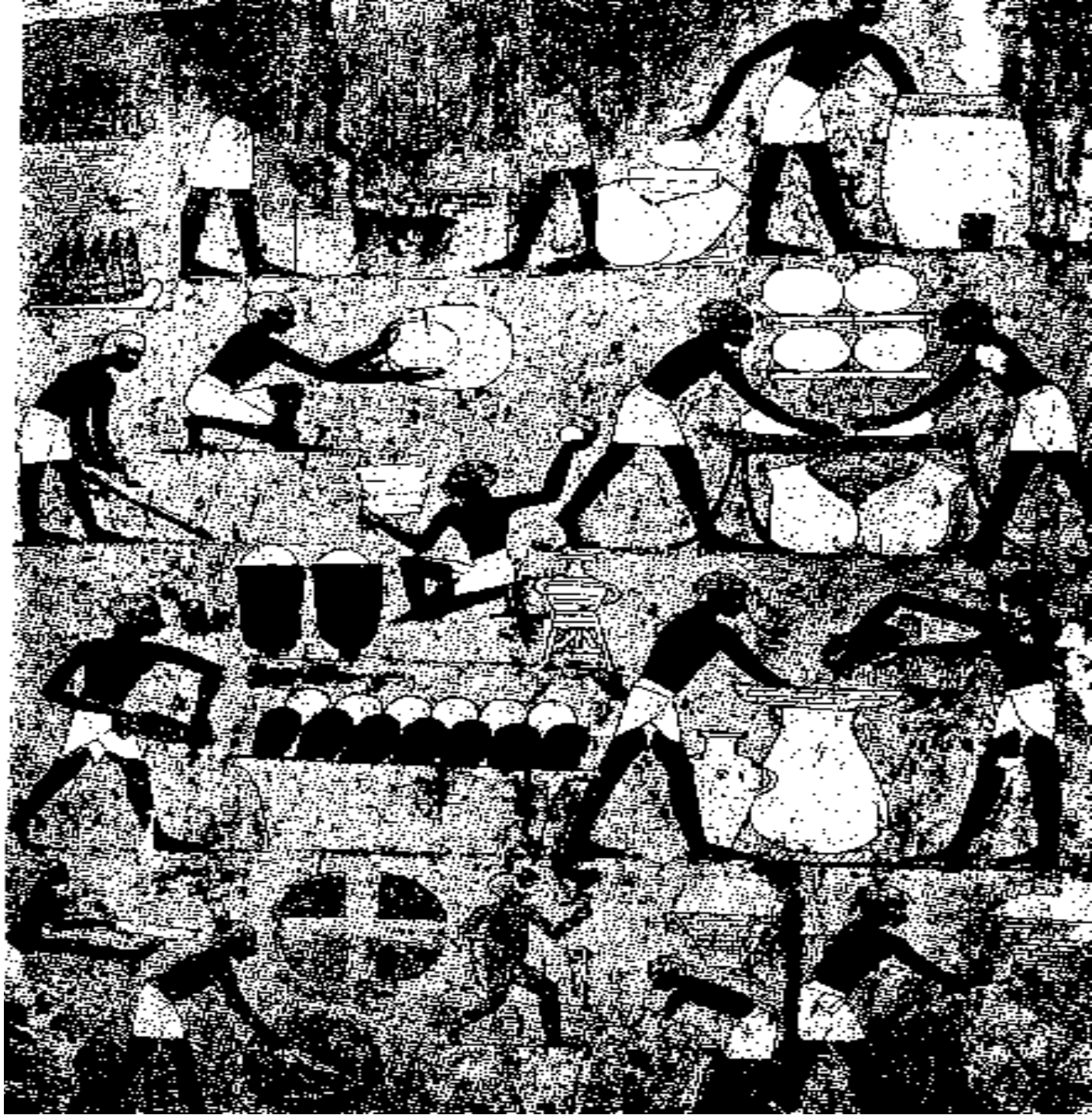
Mary-Jane Maurice, Dipl. Malt

Malteurop North America

Why Do I Say The Foundation of Beer Flavor?

- Barley has been used to make beer from the beginning

Thebes,
1500 BC

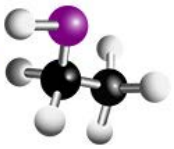


Why Do I Say The Foundation of Beer Flavor?

- Hops are a relatively new addition (2600 years after the previous illustration)
- Source of non-fermentable sugars and amino acids, as well as some volatile compounds
- Hops are flavorful, but require a solid background against which they can be balanced: beer vs. hop tea

Where Does Malt Flavor Come From?

- Is it barley variety?
  - Some varieties are beloved for their flavor
  - Others have been rejected because of it
  - Research into metabolomics, amino acid spectrum
  - We’re only beginning basic research, and it is complex!
- Is it the malting process?
  - Off-flavors from poor processing
  - Correlated with Color in specialty malts
  - Kilning conditions strongly affect final malt flavor

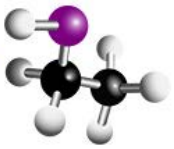


Flavor and Aroma

- Flavor and Aroma are a combination of both the presence of and the absence of chemical compounds
- Certain flavors are more likely to mask others, whether good or bad
- Important to remember when doing research
- May explain some varietal differences

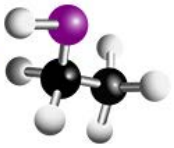
Malt Flavor Components

Constituent	End Products In Wort/Beer
Fermentable Sugars	Maltose, Glucose (Taste-Sweet)
Polysaccharides and Higher Dextrins	Maltotetrose and higher (Mouthfeel)
Nitrogenous	Amino Acids, Peptides (Taste-Bitter)
Phenolics	Guiaiacol, Ferulic Acid, Catechin, Cresol (Taste, Mouth Feel)

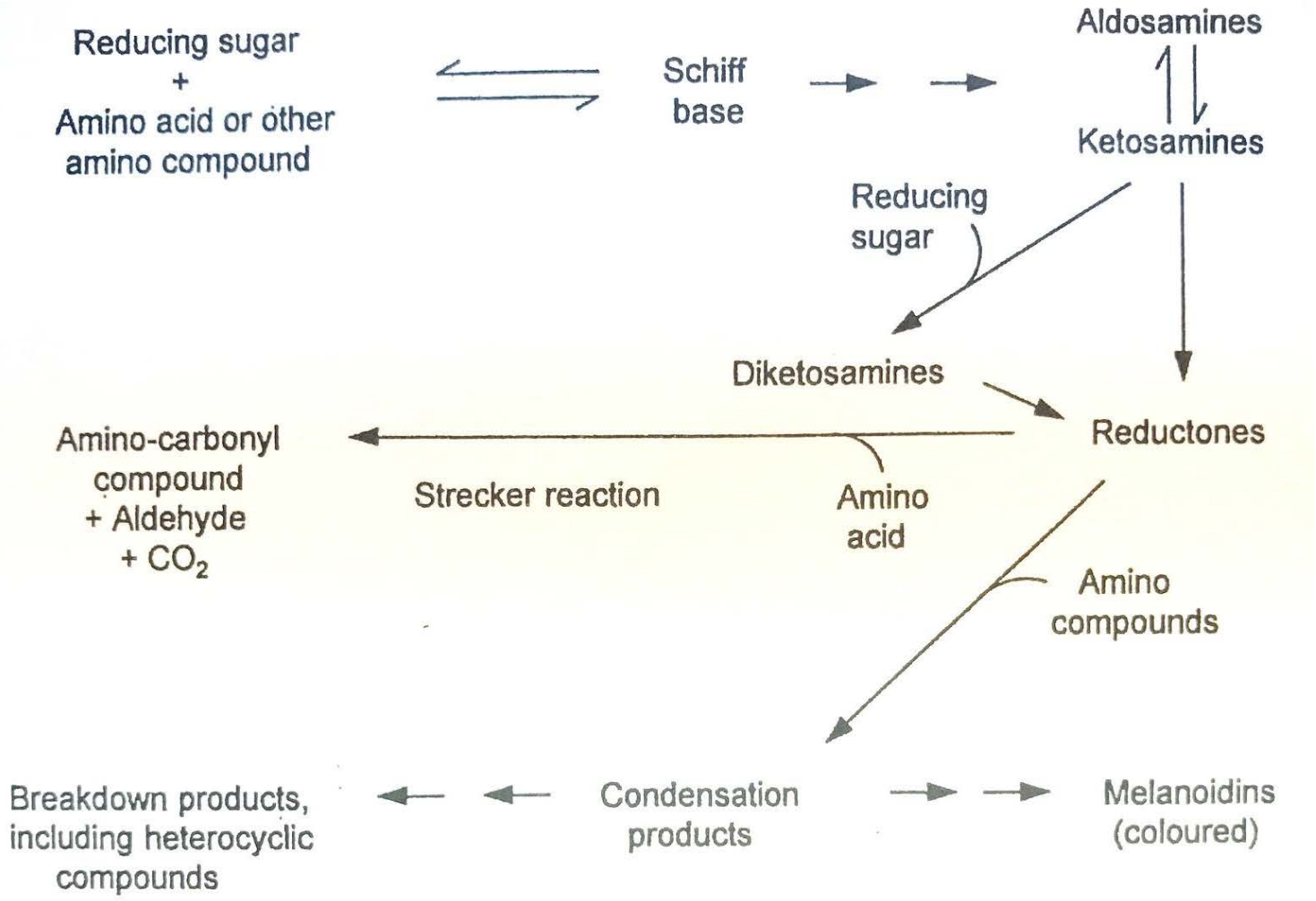


Malt Flavor Components

Constituent	End Products In Wort/Beer
Sulfur Compounds	Dimethyl Sulfide (Aroma)
Maillard Reaction Products	Heterocyclic Compounds Containing N,S and O (Taste - Nutty, Toasted, Caramel)
Lipids	FFA, Trigylcerides, Aldehydes (Taste)

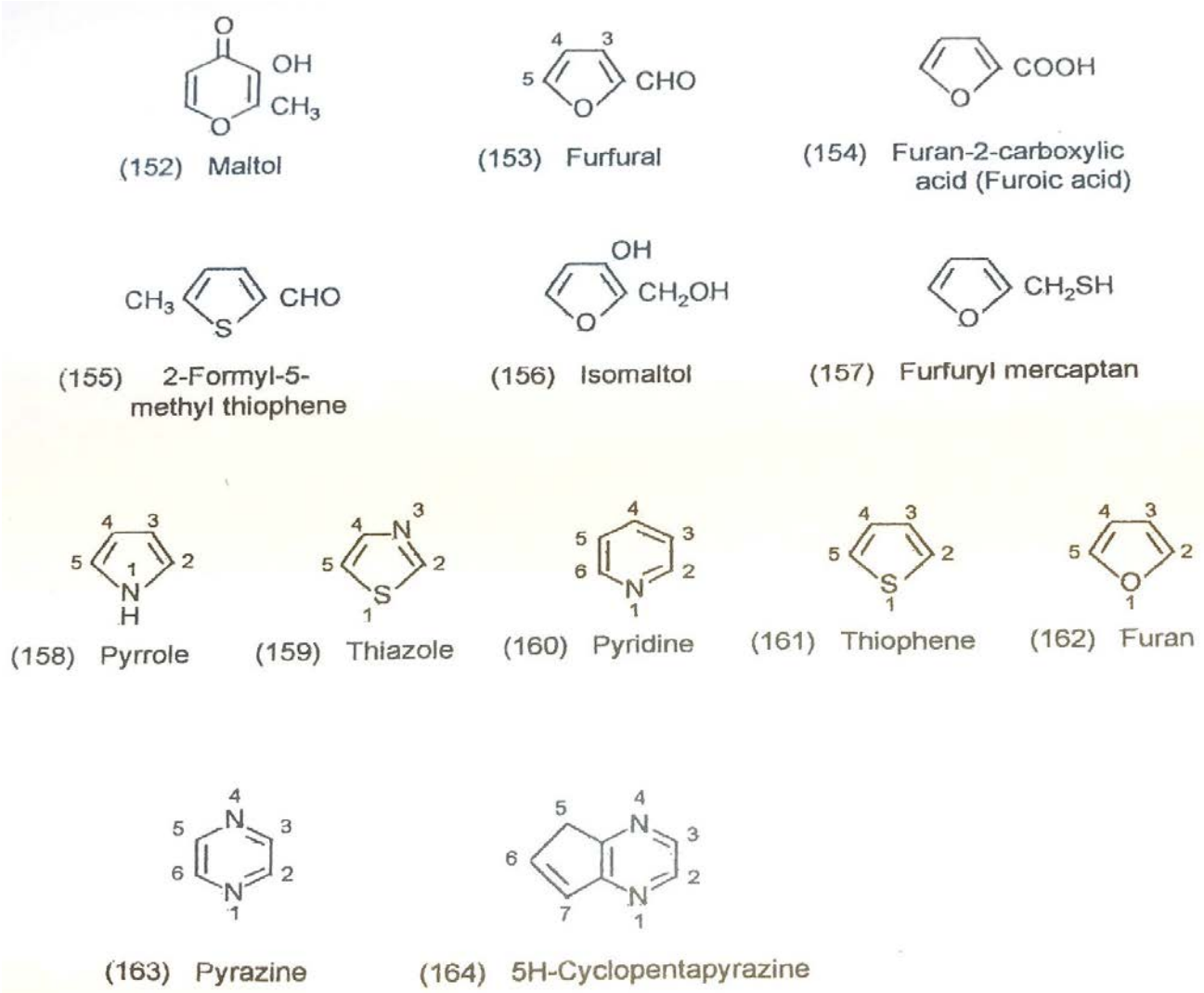


Chemical Steps in Color and Flavor



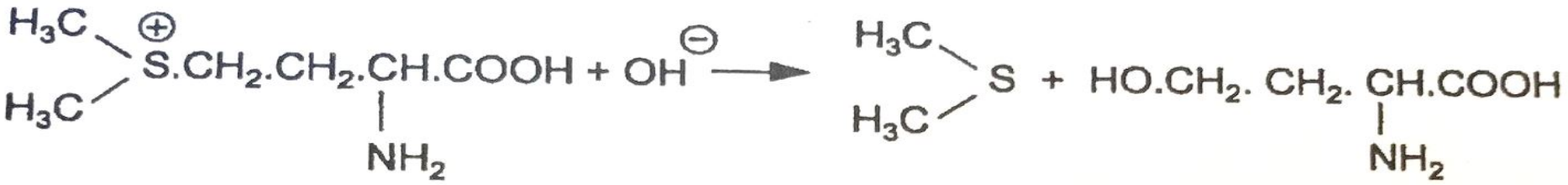
Briggs' "Malts and Malting" p221.

Heterocyclic Compounds



Briggs' "Malts and Malting" p222.

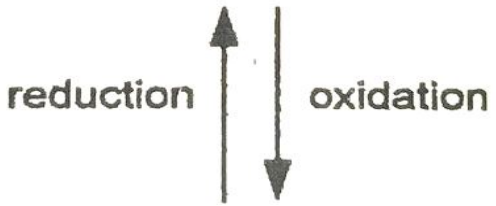
Dimethyl Sulfide

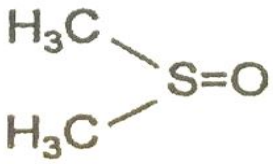


(165) *S*- Methylmethionine (SMM)

(166) Dimethyl sulphide (DMS)

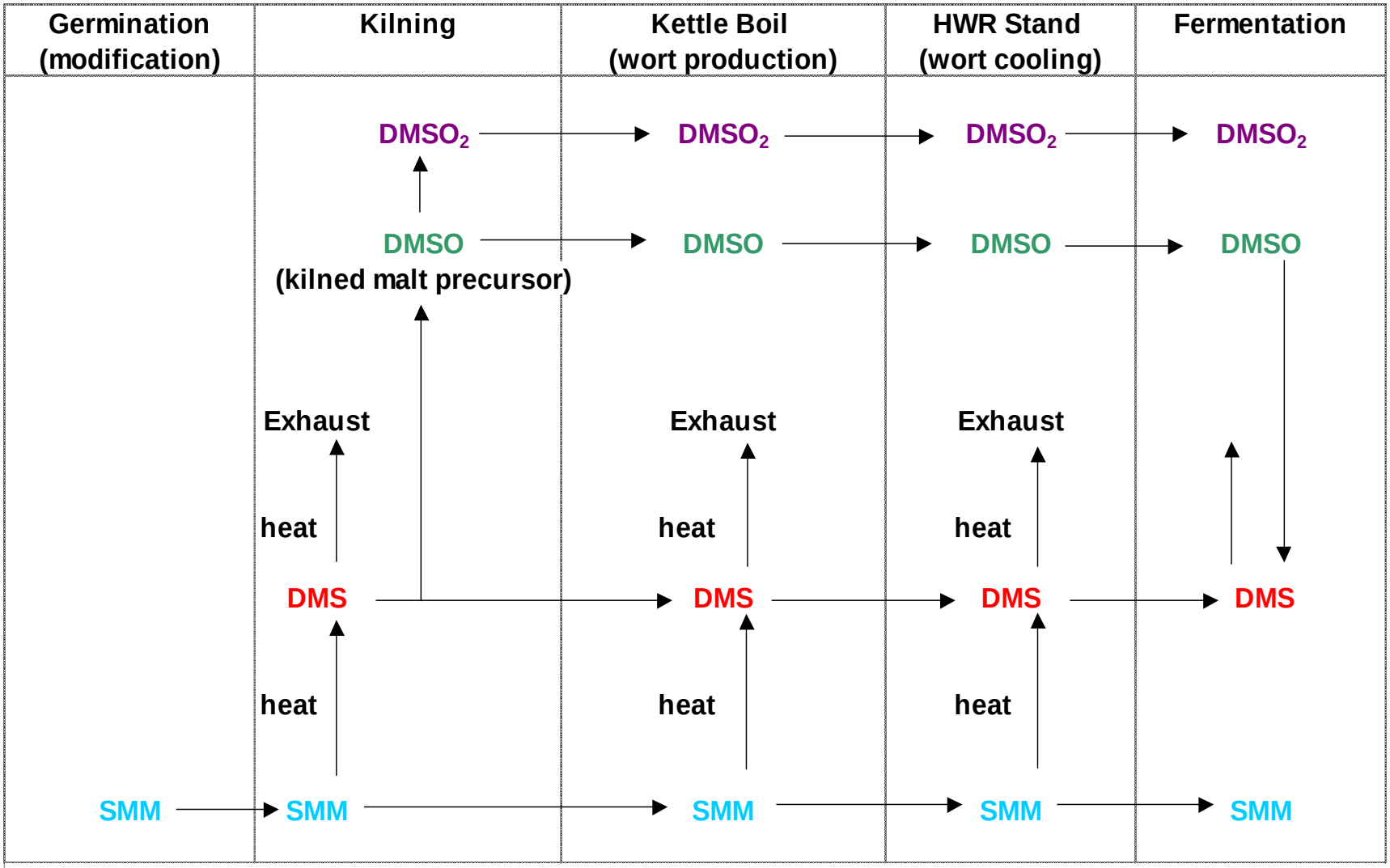
(167) Homoserine





(168) Dimethyl sulphoxide (DMSO)

Briggs' "Malts and Malting" p225



SMM = S-methyl methionine
DMS = Dimethyl sulfide
DMSO = Dimethyl sulfoxide
$DMSO_2$ = Dimethyl sulfone

Off-flavors From Processing

- Poor airflow
  - Musty
  - Sour
- Poor sanitation
  - Moldy
  - Barnyard
- Insufficient kilning
  - DMS
  - Green/Grassy/Sprouty

Off-flavors From Storage

- Stale
- Papery
- Cardboard
- Musty
- Moldy
- Dusty

Mild Negatives

- Grainy
- Husky

Positive Attributes

- Depends on malt style and processing
  - Malty
  - Toasty
  - Biscuit
  - Cookie
  - Graham Cracker
  - Post Grape Nuts
  - Caramel
  - Toffee
  - Brown Sugar

Absence of Positives or Negatives

- Thin (wort only)
- Bland
- Watery (wort only)

Mouthfeel

- Astringent
- Dry
- Metallic

ASBC Malt Lexicon Project

- 2017 project using the Briess Hot Steep Malt Sensory method, led by Lindsay Barr and Cassie Liscomb
- Randomized, blind structure
- 15 Malting, Brewing, and Academic participants
- Goal was organic descriptor generation

ASBC Malt Lexicon Project

Bready		Grainy	Floral	Sweet Aromatic	Vegetal
Dough	Yeasty	Oats	Clover	Honey	Cucumber
Dough	Play-Doh	Raw Barley	Dandelion	Caramel	Sprouts
Bread	Toast	Cooked Rice	Wildflower	Toffee	Green Bean
Bread	Bread Crumb	**Nutty**	Honeysuckle	Chocolate	Alfalfa
Bread	Bread Crust	Almond	**Fruity**	Cake	Asparagus
Bread	Biscuit	Walnut	Melon	Brown Sugar	Celery
Bread	Pretzel	Pecan	Apple	Vanilla	DMS
Bread	Flour	Peanut	Watermelon	**Woody**	**Dairy**
Sweet Bread	Sugar Cookie	Sunflower See	Lemon	**Chemical**	Butter
Sweet Bread	Graham Cracker	**Earthy**	**Grassy**	Chlorine	Milk
Cracker	Wheat Thin	Barnyard	Hay	**Medicinal**	**Meaty**
Cracker	Saltine	Dirt	Dry Grass	**Smoke**	**Rotten**
Cracker	Cheese Cracker	Moss	Hemp	**Stale**	Compost
Breakfast Cereal	Grape Nuts	Mineral	Dry Weeds	Musty	Sulfur
Breakfast Cereal	Cheerios	Soil	Burlap	Papery	Sweaty
Breakfast Cereal	Corn Flakes	Pond Water	Green Plants	Cardboard	Wet Dog
Breakfast Cereal	Bran Flakes	**Tea**	**Spicy**	Mold	**Waxy**
Breakfast Cereal	Shredded Whea	Green Tea	Cinnamon	**Metallic**	Goat
Breakfast Cereal	Oatmeal	Black Tea	Black Pepper		
Pasta		Sweet Tea			

2017 ASBC Meeting

Malt Chews

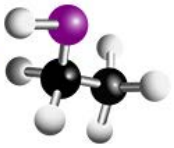
- Maltster’s and Brewer’s Best Friend!
- Best when done consistently
- Identifies flavor outliers as well as progress toward target flavor
- Screen sample if possible to avoid dust
- Allow chewed malt to blend with saliva before retronasal tasting
- Do not oversample- husk, starch can blind palate quickly, especially if tasting >1

Congress Wort / Hot Steep Tasting

- Schedule before lunch: ham is not a valid descriptor!
- Wort should be room temperature or very close
- Taste promptly
- How many is too many?
- Train frequently!

Congress Wort / Hot Steep Tasting

- Bunny sniffs
- 3 to 4 small sips
  - 1st Overall impression, whole mouth plus retronasal
  - 2nd Basic tastes
  - 3rd Mouthfeel
  - 4th Aftertaste
- Keep sips small to reduce palate blinding
- To cracker or not to cracker….



Today's Exercise

- Unfortunately fresh brewery or Congress wort were not feasible
- Hot steep method also tough because there is not consistent 65C water available
- So we adapt to what we can do!
- Thank you Aroxa!

Sample Number 1

- Sniff
- Sip, Swish, and Swallow
- Retronasal exhalation

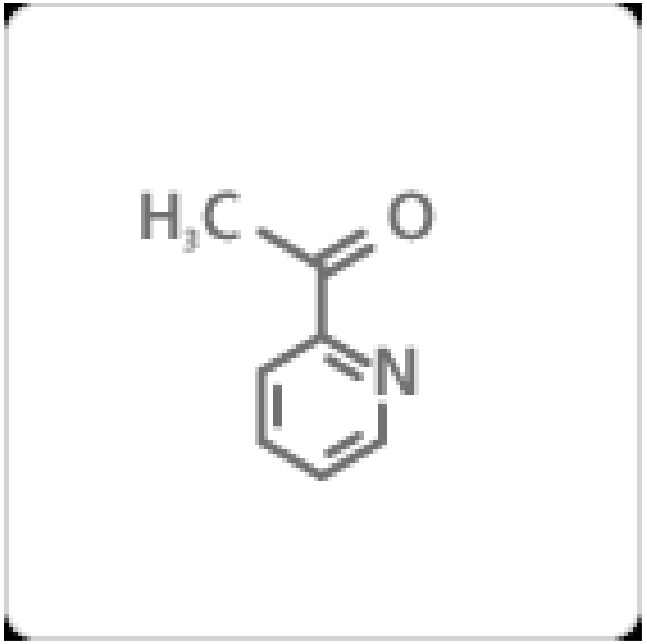
- Mouthfeel not likely to be picked up in these samples

Sample Number 2

- Sniff
- Sip, Swish, and Swallow
- Retronasal exhalation

Sample Number 2

- Aroxa Malty-Biscuity standard
- 2-acetyl pyridine
- 2x strength

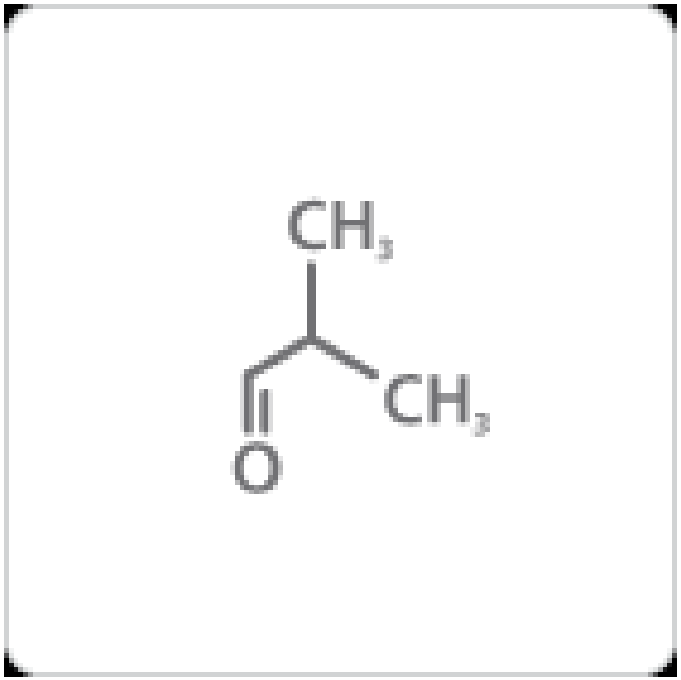


Sample Number 3

- Sniff
- Sip, Swish, and Swallow
- Retronasal exhalation

Sample Number 3

- Aroxa Grainy standard
- Isobutyraldehyde
- 2x strength

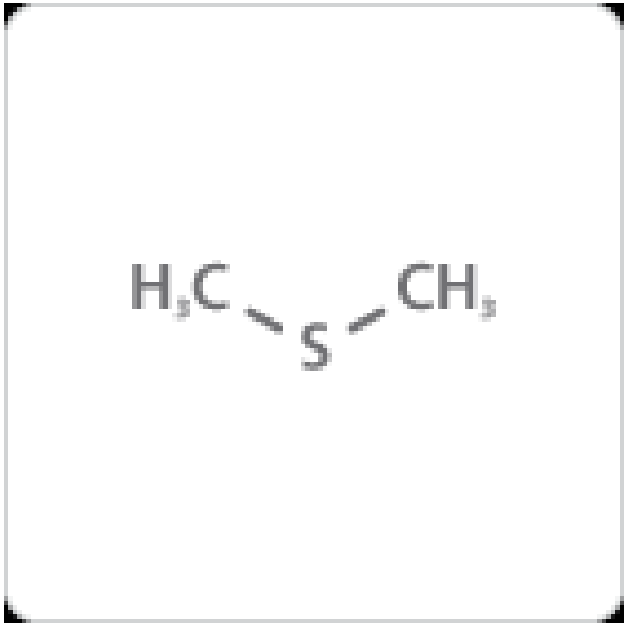


Sample Number 4

- Sniff
- Sip, Swish, and Swallow
- Retronasal exhalation

Sample Number 4

- Aroxa DMS standard
- Dimethyl sulfide
- 1x strength

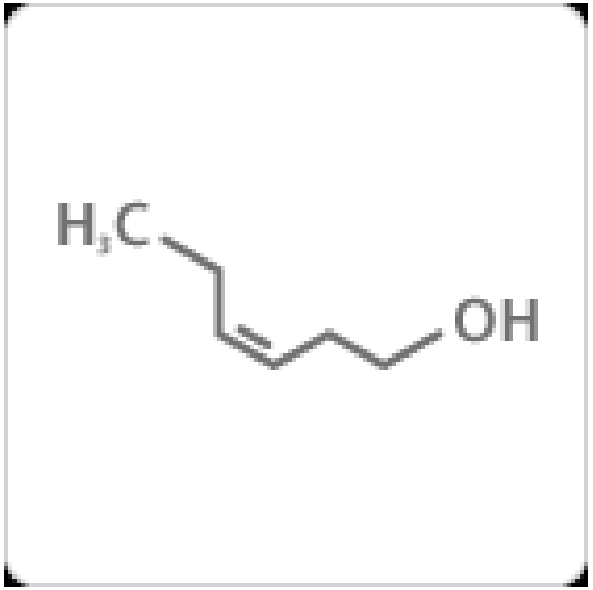


Sample Number 5

- Sniff
- Sip, Swish, and Swallow
- Retronasal exhalation

Sample Number 5

- Aroxa Freshly-cut Grass standard
- Cis-3-hexanol
- 1x strength

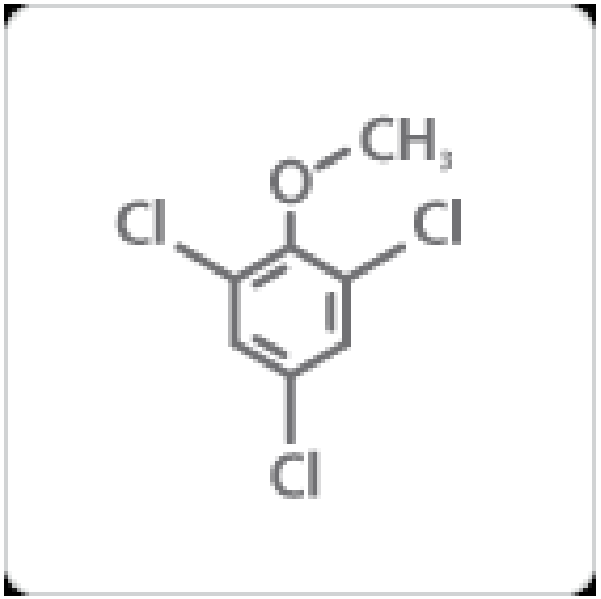


Sample Number 6

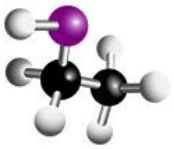
- Sniff
- Sip, Swish, and Swallow
- Retronasal exhalation

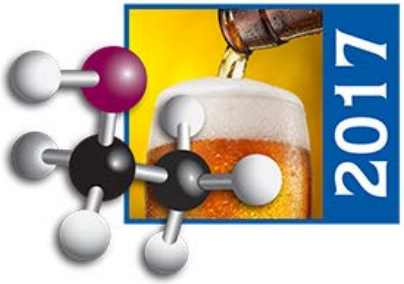
Sample Number 6

- Aroxa Musty standard
- 2,4,6-trichloroanisole
- 1x strength



Questions?





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Thank You!

Mary-Jane Maurice, Dipl. Malt

Malteurop North America