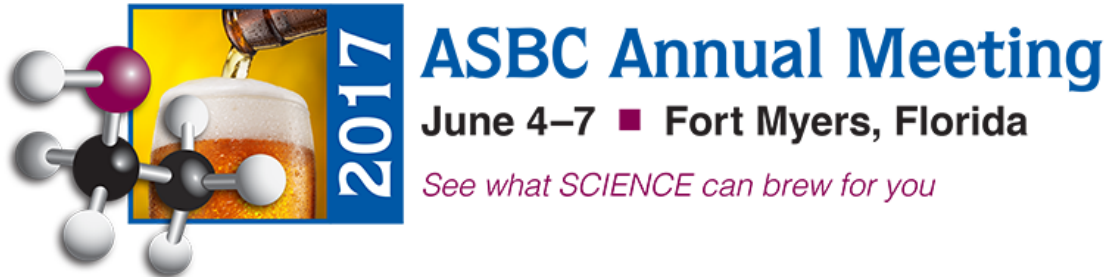


Flavor defects of beer

Dr Bill Simpson
Cara Technology, UK



Overview

- ▲ **Flavor defects**
- ▲ **The importance of specificity**
- ▲ **Common defects**
- ▲ **Tasting**



Typical beer flavors

Typical beer flavors



Types of flavor defects

Off-flavor

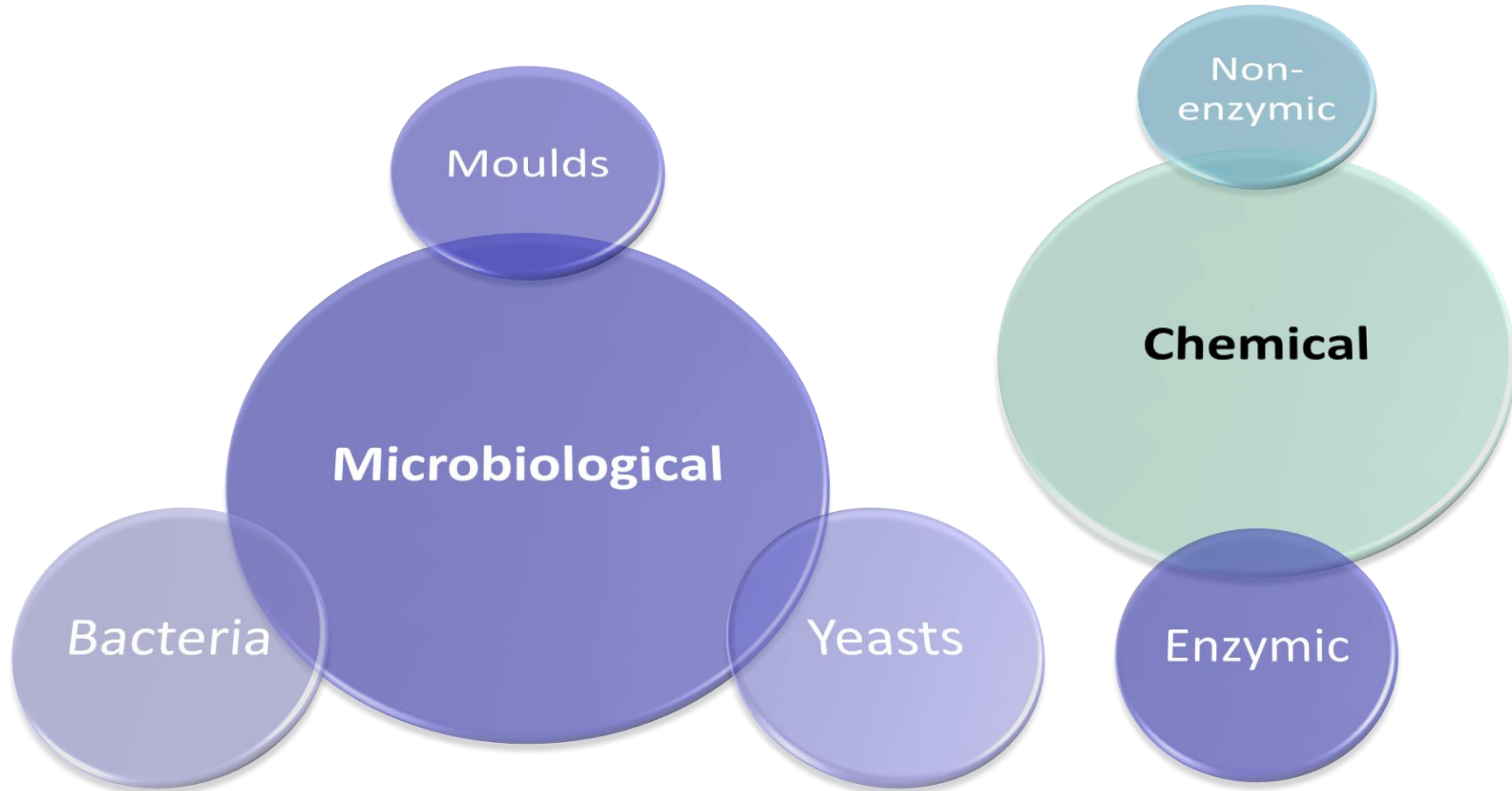
An 'atypical' flavor generated within the product by chemical or biological reactions - often present in 'sound' product, but at acceptable levels

Taint

A flavor contributed to the product from an external source *via* a 'vector' – usually absent from 'sound' product

Origins of off-flavors

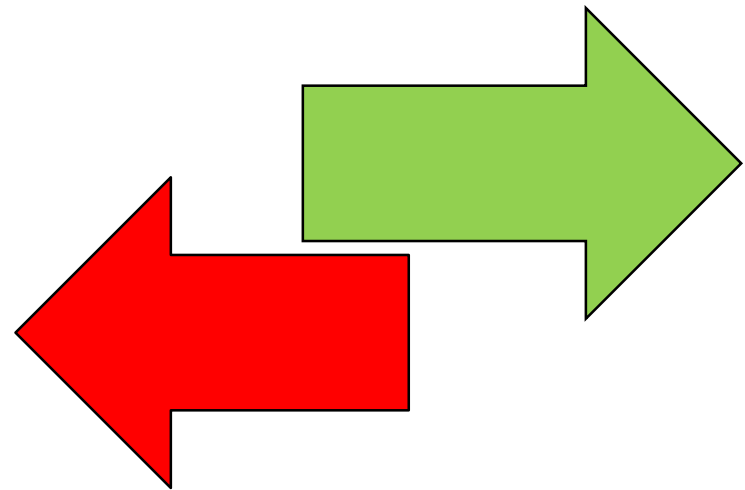
ORIGINS



Taint

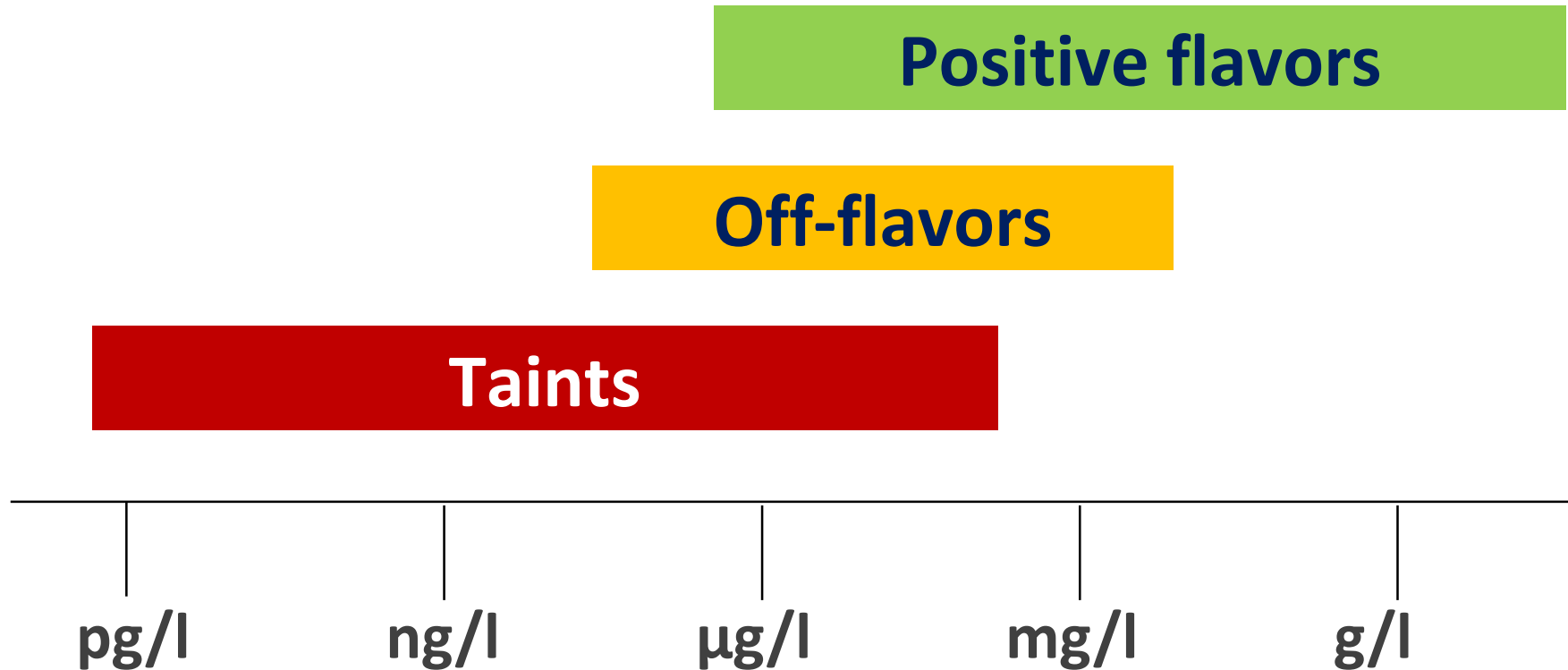
'vectors'

- ▲ **Ingredients**
- ▲ **Water**
 - ▶ **Product water**
 - ▶ **Process water**
- ▲ **Gases**
 - ▶ **Environmental air**
 - ▶ **Process gases**
- ▲ **Packaging materials**
- ▲ **Environment**



Flavor impact

Flavor impact



“Impact concentration”

Some compounds can cause product recalls when present at <10 ng/l in the final product

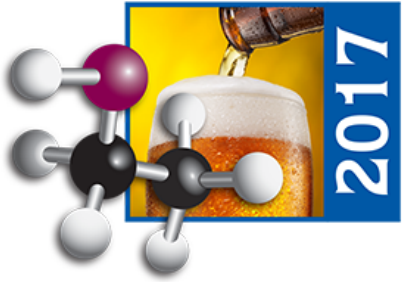
Consumer impact

subject

1. “It’s different”
2. “It’s not quite right”
3. “I’m not sure I like this”
4. “There’s something wrong here”
5. “I’m worried”
6. “Help!”



**Our choice of flavor
terms and the
standards used
represent them must
facilitate action – they
must be authentic,
consistent and pure**



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Common flavor defects of beer

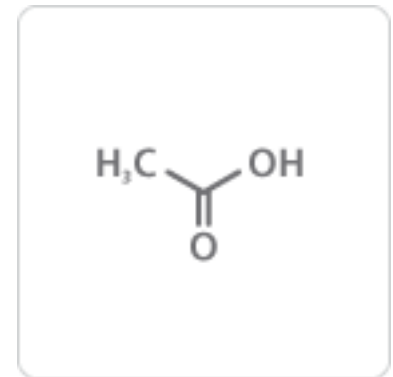
Acetaldehyde

- ▲ Positive flavor at low concentrations
- ▲ Off-flavor at higher concentrations
- ▲ Produced by yeast during fermentation
- ▲ Critically affected by wort [Zn] and yeast health
- ▲ Can also be produced by contaminant bacteria and as a result of beer oxidation
- ▲ Flavour threshold 5 mg/l



Acetic

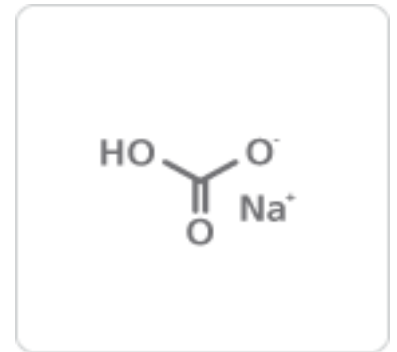
- ▲ Positive flavor at low concentrations
- ▲ Off-flavor at higher concentrations
- ▲ Produced by yeast during fermentation
- ▲ Concentration depends on yeast strain, yeast growth and yeast growth rate
- ▲ Can also be produced by contaminant bacteria – *Acetobacter* spp and *Gluconobacter* spp
- ▲ Flavour threshold 90 mg/l



Alkaline



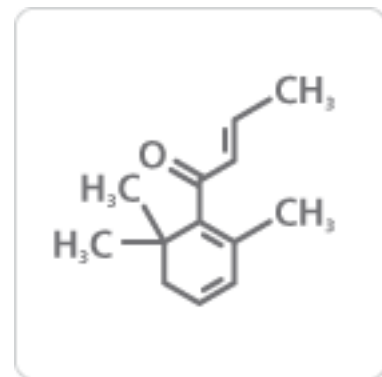
- ▲ Taint in beer
- ▲ Contributed to beer through contamination with caustic cleaning agents (such as NaOH)
- ▲ Beer sodium content and colour are also increased
- ▲ Only 'trace' concentrations of cleaning agents are needed to spoil beer flavour



Damascenone



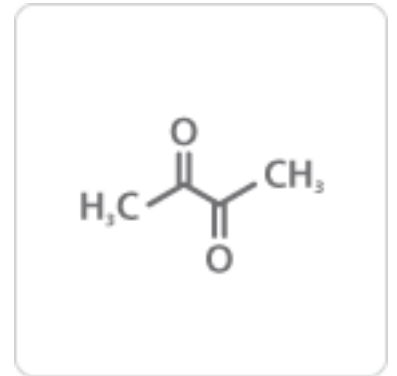
- ▲ Off-flavor in lager beer – positive flavor in hoppy ale
- ▲ Produced by breakdown of hop-derived precursors during beer storage – concentration increases with beer age
- ▲ Present in fresh beer when a lot of hop material is used
- ▲ Flavour threshold 0.025 mg/l



Diacetyl



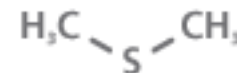
- ▲ Positive flavor at low concentrations
- ▲ Off-flavor at higher concentrations
- ▲ Precursor is produced by yeast during fermentation
- ▲ Influenced by wort amino acid concentrations and beer pH value
- ▲ Can also be produced by contaminant bacteria – *Lactobacillus* and *Pediococcus* spp
- ▲ Flavour threshold 0.01 mg/l



DMS

DMS

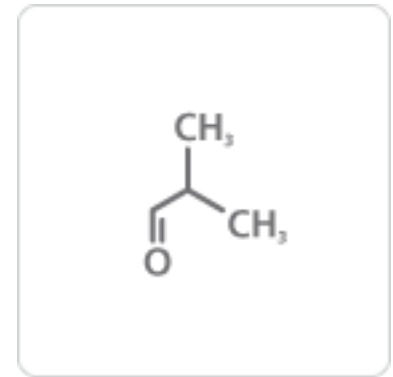
- ▲ **Positive flavor in some types of beer (not just lagers)**
- ▲ **Off-flavor in other beers**
- ▲ **Derived from precursors in malt**
- ▲ **Concentration depends on malt specifications, brewhouse procedures and fermentation practices**
- ▲ **Can also be produced by contaminant microorganisms**
- ▲ **Flavour threshold 0.03 – 0.05 mg/l**



Grainy



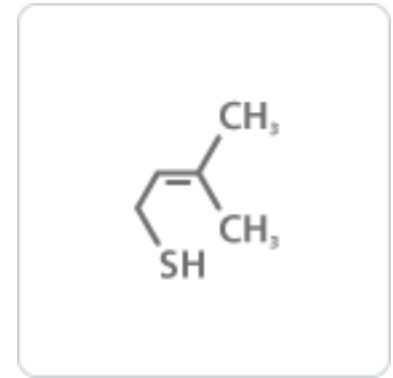
- ▲ **Positive flavor at low concentrations**
- ▲ **Off-flavor at higher concentrations**
- ▲ **Derived from precursors in malt**
- ▲ **Concentration depends on malt specifications, brewhouse procedures and fermentation practices**
- ▲ **Other aldehydes can contribute to the grainy characteristics of beer**
- ▲ **Flavour threshold 0.01 – 0.025 mg/l**



Lightstruck

LIHTSTRUCK

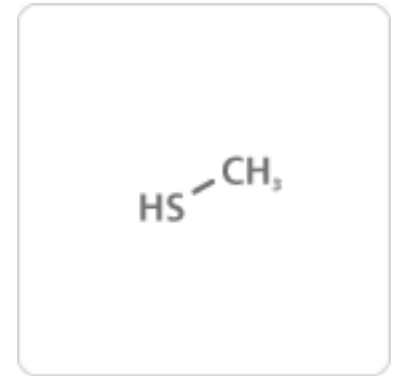
- ▲ Off-flavor in beer
- ▲ Caused by exposure of beer to light
- ▲ Precursors are hop bitter acids, vitamins and sulphur compounds
- ▲ Beers which have been bittered with specially modified hop extracts do not develop this character
- ▲ Flavour threshold 4 – 30 ng/l



Mercaptan

Welcabrau

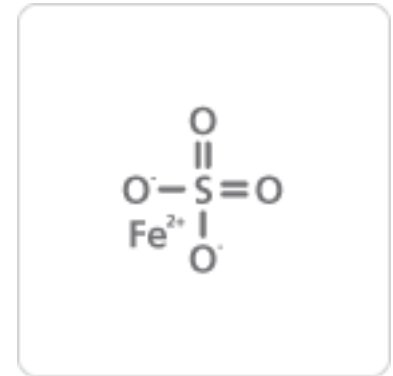
- ▲ Off-flavor in lager beer
- ▲ Produced by yeast during maturation
- ▲ Caused by methanethiol
- ▲ Concentration depends on yeast strain, yeast health and fermentation conditions
- ▲ Can also be produced by contaminant microorganisms
- ▲ Flavour threshold 0.0015 mg/l



Metallic



- ▲ Taint in beer
- ▲ Contributed to beer through contamination with metal ions, either from raw materials or corrosion of brewery equipment
- ▲ Iron, copper and manganese can all give metallic flavours
- ▲ Detected by 'trigeminal' sense and by odour
- ▲ Flavour thresholds in the region of 0.05 – 0.3 mg/l

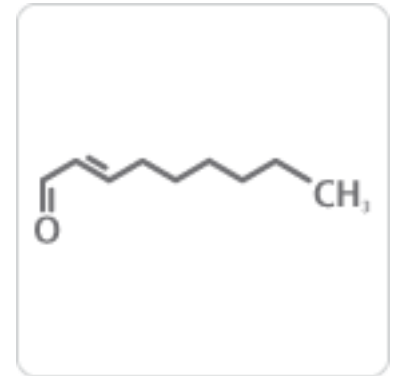


Lipid oxidation products from hops can also give this flavor

Papery



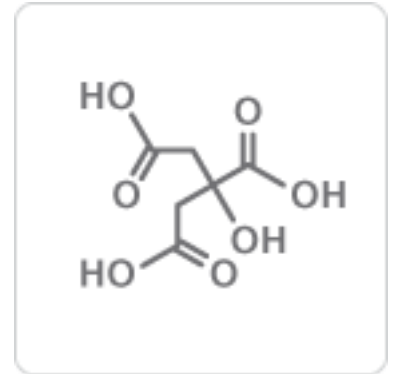
- ▲ Off-flavor in beer
- ▲ Produced by breakdown of malt-derived lipids
- ▲ Compound binds to malt proteins in wort boiling and is carried through the brewing process
- ▲ Released during storage of packaged beer
- ▲ Flavor suppressed by sulphur dioxide
- ▲ Flavour threshold 50 – 250 ng/l



Sour

2011

- ▲ Positive flavor at low concentrations
- ▲ Off-flavor at higher concentrations
- ▲ Taste characteristic
- ▲ Produced by yeast during fermentation
- ▲ Influenced by amount of yeast growth and rate of yeast growth
- ▲ Can also be produced by contaminant bacteria
- ▲ Flavour threshold 60 mg/l



Pure beer flavor compounds – covering all important attributes



- ▲ Free of sensory impurities
- ▲ Stabilized by encapsulation
- ▲ Extensively analysed and validated
- ▲ Added to beer to create training samples

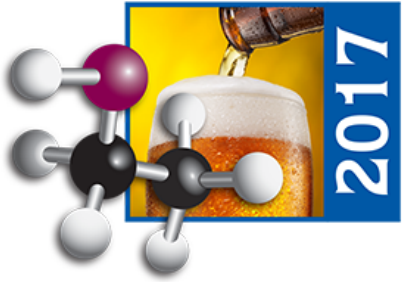
The importance of “sensory purity”

99.9%

- ▲ Each of us is “blind” to several flavor compounds - this genetically-inherited ‘blindness’ is called anosmia
- ▲ Trace contaminants are often present in odour-active chemicals
- ▲ Their presence can cause people who are anosmic to a specific chemical to believe they can detect it, and others to mistake its flavor character for something else

*GC-
olfactometry
can be used
to assure the
sensory
purity of
flavor
standards
used in
training*



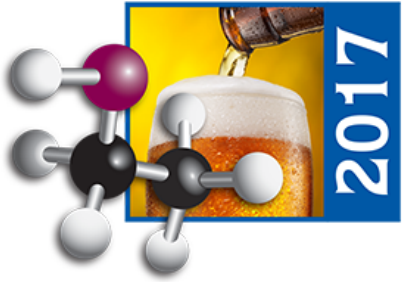


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Tasting



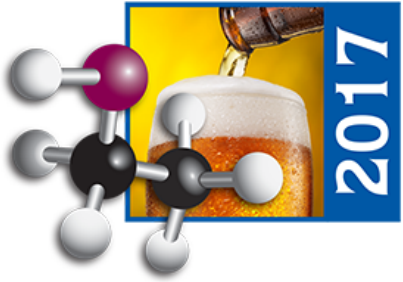
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Smoky





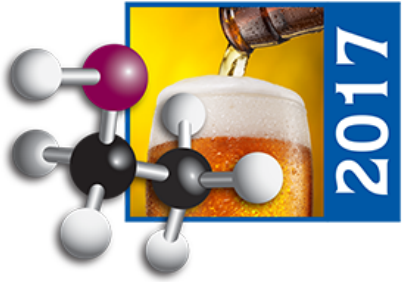
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Phenolic – 4-EP





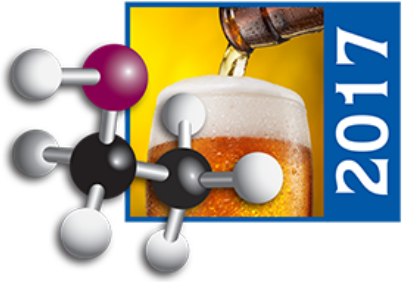
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Diacetyl





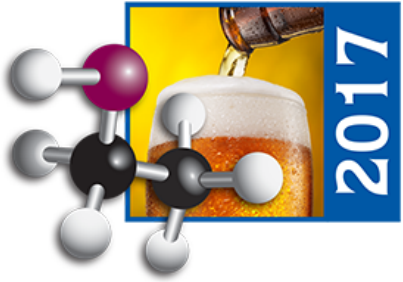
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Papery





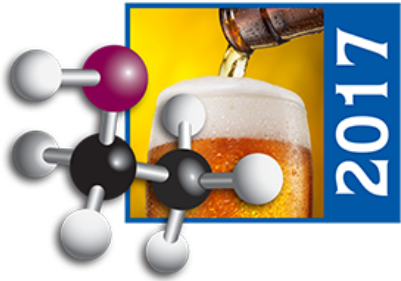
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Earthy - compost





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Indole



Summary and conclusions

- ▲ What we regard as a “flavor defect” in beer is not static, but evolving
- ▲ If we are to take action to address flavor defects, the ones we look for have to be specific – “papery” rather than “oxidized”
- ▲ Training has to use “sensory pure” materials or we risk learning to recognize the wrong flavor
- ▲ In addition to having a great taste panel, we also need knowledge about the origins and methods of control of each flavor

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