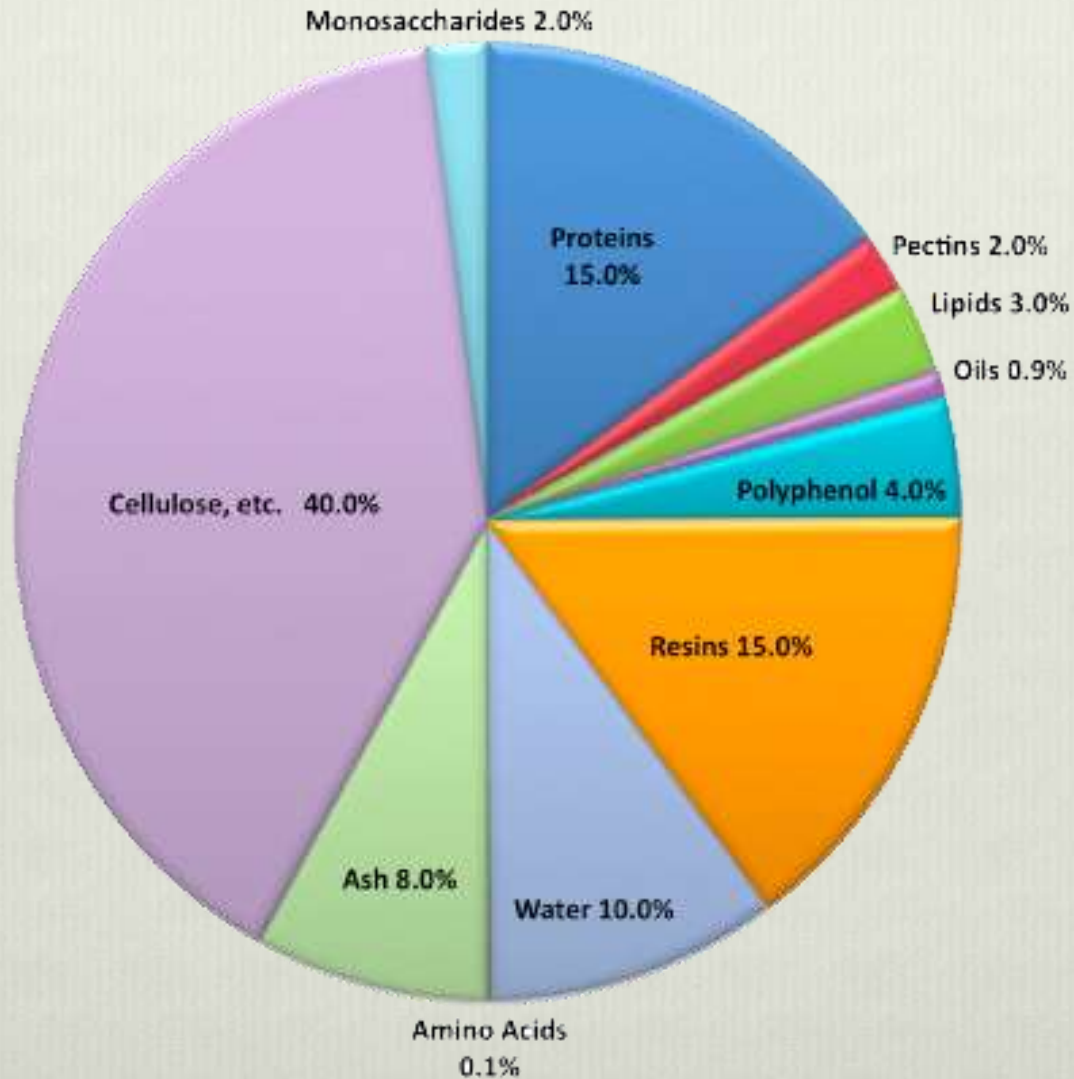


Humulones

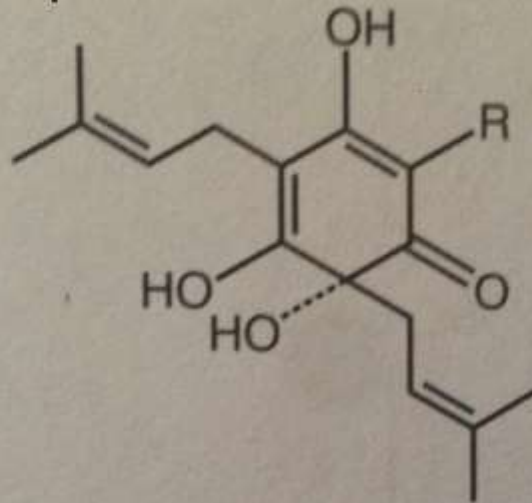
It's getting hot in here

Hop Components



Resins

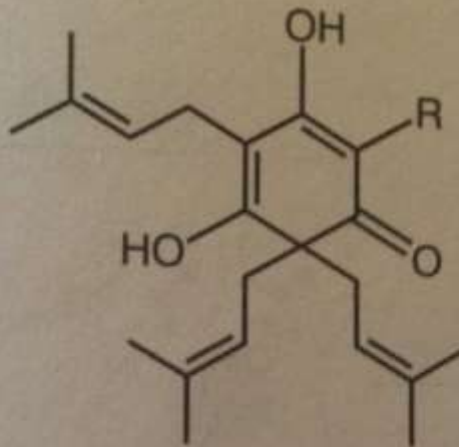
❖ α - acids



Name	Side Chain (R)
Humulone	$-\text{CO}\cdot\text{CH}_2\cdot\text{CH}(\text{CH}_3)_2$ isovaleryl
Cohumulone	$-\text{CO}\cdot\text{CH}(\text{CH}_3)_2$ isobutyryl
Adhumulone	$-\text{CO}\cdot\text{CH}(\text{CH}_3)\cdot\text{CH}_2\cdot\text{CH}_3$ 2-methylbutyryl

Resins

❖ β - acids



Name	Side Chain (R)
Lupulone	$-\text{CO}\cdot\text{CH}_2\cdot\text{CH}(\text{CH}_3)_2$ isovaleryl
Colupulone	$-\text{CO}\cdot\text{CH}(\text{CH}_3)_2$ isobutyryl
Adlupulone	$-\text{CO}\cdot\text{CH}(\text{CH}_3)\cdot\text{CH}_2\cdot\text{CH}_3$ 2-methylbutyryl

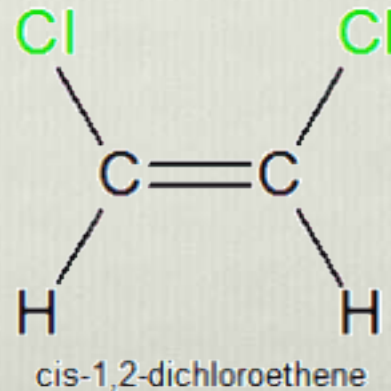
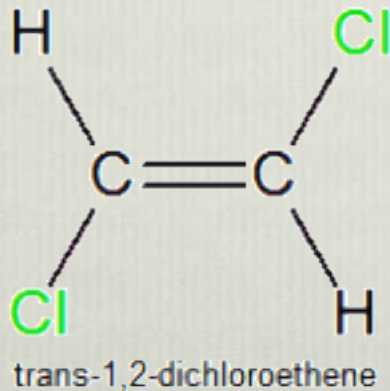
eta acids.

The Boil

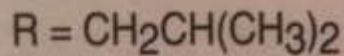
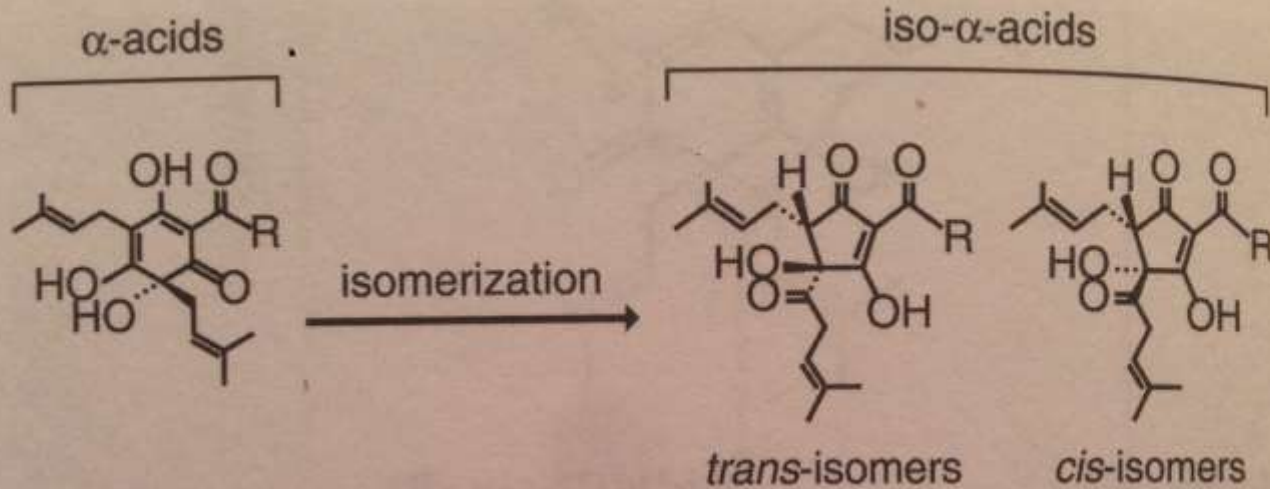
- ❖ Sterilization
- ❖ Protein Precipitation (“Hot Break”)
- ❖ Bittering/isomerization of α - acids
 - ❖ Insoluble in wort & beer
 - ❖ Isomerization at 185 F
 - ❖ Enhanced bitterness and solubility of isomers

Isomerization

- ❖ What are isomers?
 - ❖ Re-arranged molecules
- ❖ Geometric Isomer
 - ❖ Double bonds, ring structures
- ❖ Cis/Trans Isomers

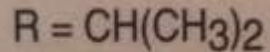


Isomerization



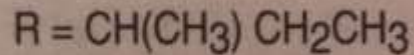
humulone

isohumulone



cohumulone

isocohumulone



adhumulone

isoadhumulone

omerization of alpha acids.

Perceived Bitterness

er 13

Table 14. Relative bitterness of iso- α -acids

Compound	Typical Proportion in Beer (%)	Bitterness Rank^a
<i>trans</i> -isocohumulone	7	1
<i>cis</i> -isocohumulone	30	2=
<i>trans</i> -isohumulone	10	2=
<i>cis</i> -isohumulone	40	4
<i>trans</i> -isoadhumulone	3	?
<i>cis</i> -isoadhumulone	10	?

^a 4 indicates most bitter. Equal signs indicate identical bitterness.

Perceived Bitterness

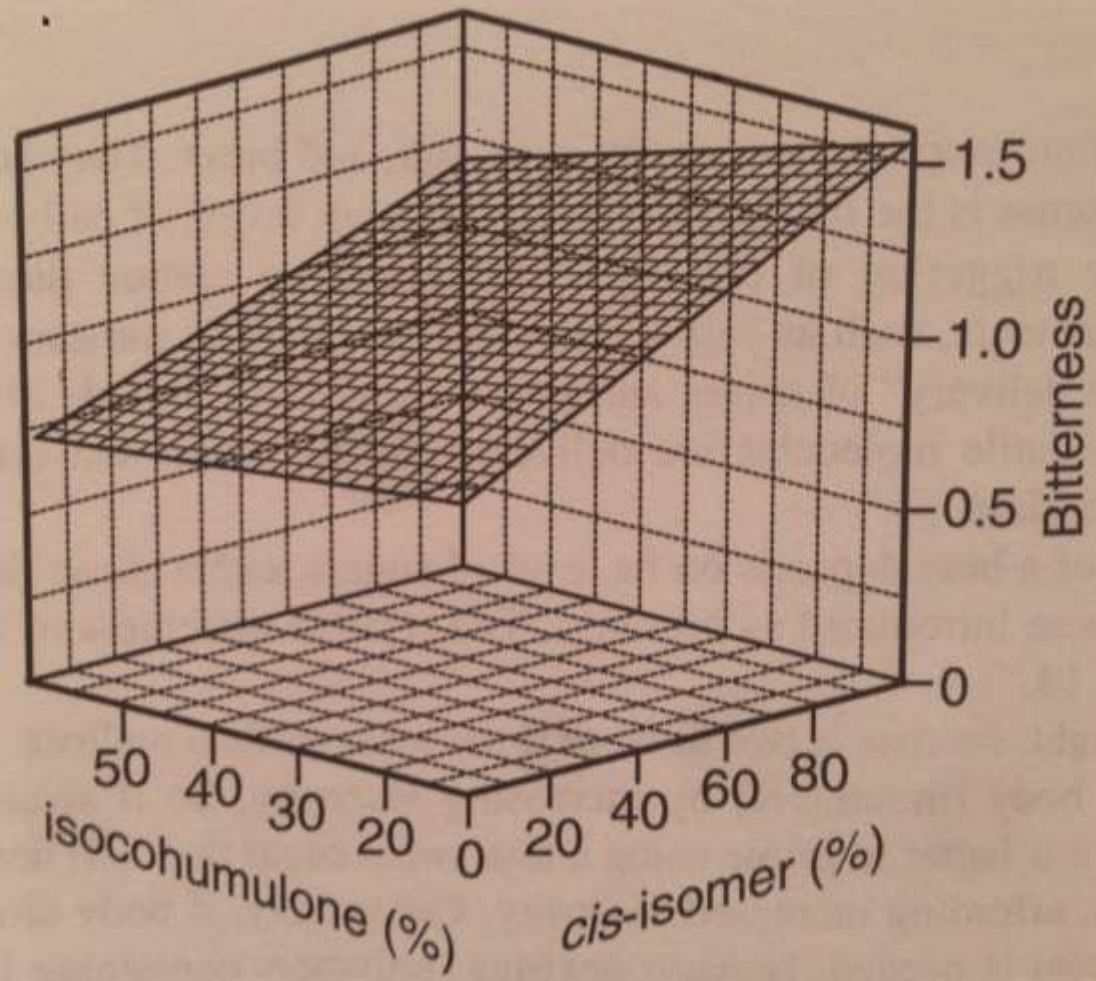


Fig. 84. Relationship between iso- α -acid isomer levels and perceived bitterness.

Bitterness Potency vs. Quality

- ❖ Potency

- ❖ Measured Analytically

- ❖ Spectrophotometer, HPLC, GC

- ❖ Quality

- ❖ Measured by Sensory Methods

- ❖ Effect of iso-humulone

- ❖ Intense bitterness, low “linger”

- ❖ Effect of iso-co-humulone

- ❖ Mild bitterness, high “linger”

Co-Humulone Hop Tiers

- ❖ Low “Linger”, sharp bitter; (Snare Drum)
 - ❖ 15 – 24% Co-humulone
 - ❖ Amarillo, Citra, Simcoe, Nelson Sauvin
- ❖ Medium “Linger”, medium bitter; (Bass Drum)
 - ❖ 25% - 29% co-humulone
 - ❖ Apollo, Nugget, Summit, Warrior
- ❖ High “Linger”, soft bitter; (Gong Drum)
 - ❖ 30+ % co-humulone
 - ❖ Bravo, Cascade, Centennial, Chinook, Columbus

Example: Green Bullet



New Zealand Green Bullet

An all-purpose Southern Hemisphere variety with a proven track record in the brewhouse.

SKU: **GRB**

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[Overview](#)

Alpha Acid Range %	11.0 – 14.0
Beta Acid Range %	6.5 – 7.0
Co-Humulone as % of alpha	41 – 43
Total oils mls/100 gr.	1.0 – 1.4

Product tags

References

- ❖ C.W. Bamforth. (2006) Scientific Principles of Malting and Brewing. American Society of Brewing Chemists.
- ❖ Michael J. Lewis. (2006) Essays in Brewing Science. American Society of Brewing Chemists.
- ❖ American Society of Brewing Chemists. (2008) “Report of Subcommittee on Determination of Isohumulones in Beer.”
- ❖ <http://www.bsgcraftbrewing.com>