

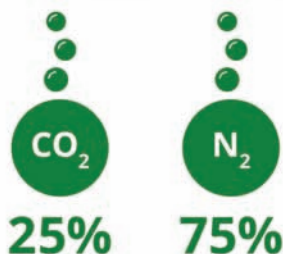
PeriodicGraphics

With Compound Interest

THE CHEMISTRY OF GUINNESS

With St. Patrick's Day upon us, we examine some of the chemicals responsible for the color and bitterness of Guinness. And we look at why bubbles in a pint of the famous beer appear to flow downward.

BUBBLE COMPOSITION



MAKEUP OF THE GAS MIX
USED TO CARBONATE GUINNESS

Most beer foam is caused by carbon dioxide bubbles, but Guinness also contains bubbles of nitrogen. These lessen the bitter taste to a degree and also make the head of the beer last longer. Nitrogen also reduces the size of the bubbles in the beverage.



WHY DO THE BUBBLES FALL?



At the center of the glass, the bubbles don't experience the drag they do at the sides, so they rise rapidly.

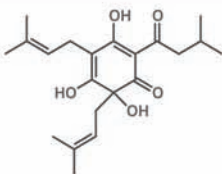


As the bubbles at the center rise, they pull the liquid with them. When the liquid reaches the surface, it flows outward, toward the sides of the glass.

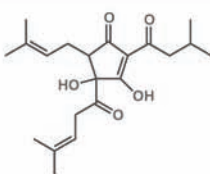


When the current flows down the sides of the glass, it's strong enough to pull smaller nitrogen bubbles with it, creating the falling effect.

WHAT CAUSES THE BITTERNESS OF GUINNESS?



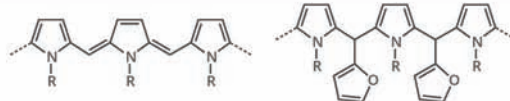
HUMULONE — AN α -ACID



ISOHUMULONE — AN ISO- α -ACID

During the brewing process, hops release the α -acid humulone. Guinness uses hops with high levels of α -acids, which isomerize when boiled to form iso- α -acids, the primary source of bitterness in beers.

THE COLOR OF GUINNESS



PROPOSED STRUCTURES FOR MELANOIDIN FRAGMENTS
(R = sugar fragments. These are just two of the many proposed structural motifs likely to occur within a single melanoidin molecule.)

The dark color of Guinness has been attributed to melanoidins. These are polymeric structures created during the malting process that give beers their dark hue. They are created by the Maillard reaction, in which sugars and proteins react when heated.



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Periodic Graphics is a collaboration between C&EN and Andy Brunning, chemistry educator and author of the popular graphics blog Compound Interest. To see more of Brunning's work, go to compoundchem.com.