

OXIDATION: CHEMISTRY AND PREVENTION

Oxygen, That \$&*! is everywhere
-Tamir Danon, Novel Strand Brewing

STAGES OF STALING

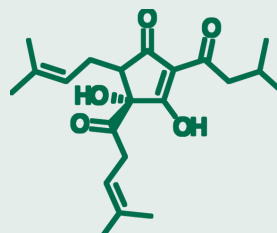
Stage A: Stable, brewery-fresh flavor

Stage B: Transition period, new flavors can be detected

Stage C: Classic known flavors indicative of staling, stable flavor profile. Papery, leathery to sherry/vinegar notes.

Stage D: Stage C flavors evolve into what is recognized in great wines.

ISO-ALPHA ACIDS



- Hop flavors
- Signals staling is underway
- Breaks off acyl-side chains through the oxidation mechanism resulting in acids
- Formation of fatty acids with stale and cheesy notes
- Isohumulone is oxidized to isovaleric acid

AUTOOXIDATION MECHANISM



TRANS-2-NONENAL

- Long chain unsaturated aldehydes (e.g. T-2-N)
- Powerful paper/cardboard flavor with extremely low flavor threshold
- Short chain aldehyde precursors-neutral in flavor but readily condense into longer chains
- Causes
 - Oxygen during wort production
 - Enzymatic oxidation from ingredients like malt and barley
- Can be slowed through bonding with sulfur compounds for a time from the yeast metabolism

METHODS OF PREVENTION BREWHOUSE PACKAGING

Methods of prevention in stainless



- Change gaskets once every 6 mo
- Watch your brite tank purge SOP
- Flush transfer hoses w/CO₂
- Dry hop under positive pressure
- Measure tank DO

Methods of prevention in packaging

- Get a baseline for canning line DO
- Balance BBT CO₂ vs. foam at can
- Replace clear tubing every 6 mo
- Change out worm gear clamps
- Measure canning DO often



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Say What?!

1 cubic cm of air in Denver, CO equates to 100 ppb of DO in a 1.7 BBL vessel.

Remember, O₂ is everywhere, and the less you can have in your product, the better!

