

Assessing Beer Oxidative Aging Using UV-VIS Spectrophotometry DR6000

Objective

To quantitatively assess the **oxidative aging of beer** by determining the **Staling Index (SI)** using UV/VIS photometry on the Hach DR6000. This method enables breweries and quality control labs to monitor product freshness over time.



Background and Principle

During storage, beer undergoes oxidative reactions, leading to:

- Formation of **aldehydes** (e.g., 2-furfural, Strecker aldehydes)
- **Maillard reactions**, causing browning
- Polymerization of **polyphenols and proteins**, leading to haze

These changes affect the UV-VIS absorption spectrum of beer. Two wavelengths are particularly informative:

Wavelength (nm) Significance

275 nm	Absorption by aromatic aldehydes/oxidation products
430 nm	Beer color intensity (Maillard products)

The **Staling Index (SI)** is calculated as:

$$SI = \frac{\text{Absorbance at 275nm}}{\text{Absorbance at 430nm}}$$

- A low SI suggests a fresh beer
- A high SI indicates significant aging or staling

Equipment and Materials

Instrument:

- Hach **DR6000** UV-VIS Spectrophotometer
- Quartz cuvettes (10 mm path length)
- Software module for custom methods

Materials:

- Beer samples (fresh and stored for comparison)
- Ultrasonic bath or shaker for degassing
- 0.45 µm membrane filter (optional, for haze removal)
- Distilled water (for blank/reference)
- Pipettes, cuvette rack, lint-free wipes



DR6000 UV VIS Spectrophotometer

Creating a Custom Program in the DR6000

Step-by-Step Instructions:

- From the main menu, go to:
User Programs > Create New Method
- Method Name:
Beer Staling Index
- Measurement Mode:
Photometric (Absorbance)
- Add Wavelengths:
Wavelength 1: 275 nm → Label: A275
Wavelength 2: 430 nm → Label: A430
- Define Calculation:
Add a custom calculation
Formula: A_{275} / A_{430}
Label: Staling Index (SI)
Units: none
- Result Format:
Decimal output with 2 digits (e.g., 1.23)
- Blank Measurement:
Set distilled water as reference (blank) for both wavelengths
- Save the method under user programs:
e.g., SI_BEER_v1

Measurement Procedure

1. Blank Measurement:

- Fill a clean cuvette with distilled water
- Perform a zero (blank) measurement in the custom program

2. Sample Measurement:

- Fill a cuvette with degassed beer (no bubbles)
- Insert and measure
- The DR6000 will display:
 - Absorbance at 275 nm
 - Absorbance at 430 nm
 - Calculated Staling Index (SI)

Interpretation of Results

Staling Index (SI) Assessment

< 0.80	Fresh beer, no significant aging
0.80 – 1.20	Initial signs of oxidative staling
> 1.20	Clearly aged/staled, likely sensory impact

Note: Thresholds may vary slightly between beer styles (e.g., dark beers may have higher base SI values).

Quality Control Recommendations

- Perform **triplicate measurements** per sample for reliability
- Use fresh, **unscratched cuvettes**
- Maintain **constant temperature** during measurements
- Keep a **reference beer** sample (known age) for calibration or comparison

Notes and Extensions

- The SI is a **relative indicator** of freshness, not an absolute shelf life value
- Best used in conjunction with **sensory evaluation** and optionally **GC-MS** for aldehyde analysis
- Especially useful for **comparative testing**: fresh vs. stored samples, pack-aging trials, etc.

Batch Analysis & Data Export

- Use DR6000's **USB or LIMS export** to output:
 - Sample ID • A275 • SI
 - Date • A430
- Easily import into Excel for **aging curve visualization**



References

Narziß, L.: Abriss der Bierbrauerei, Vol. II | MEBAK: Methods for the Analysis of Beer, Section 2.23 (Color) | Hach DR6000 Manual and User Guide | Journal of the Institute of Brewing (2001), Vol. 107, Issue 3, 145–152