



Enhancing Nut Manufacturing with Spectrophotometric Color Measurement

Introduction

Nuts—whether raw, roasted, salted, or seasoned—are high-value snack products where appearance is a critical indicator of freshness, flavor, and quality. Consumers expect almonds, peanuts, cashews, pistachios, and other varieties to look consistent across every package. Even subtle differences in roast level or coating uniformity can lead to consumer dissatisfaction, as color is closely tied to perceptions of flavor intensity and quality.

Spectrophotometric color measurement provides an objective, repeatable method for monitoring nuts throughout production. By quantifying color at key stages, manufacturers can ensure uniformity, maintain brand identity, and reduce waste. This paper explains the role of color in nuts, the challenges of visual inspection, and how **HunterLab's Aeros spectrophotometer** provides a superior solution for roasted and coated nut products.

Importance of Color in Nuts and Roasted Nuts

- **Roast Level Indicator** - L^* values correlate strongly with degree of roasting; too light suggests under-roasting (weak flavor), while too dark signals over-roasting or burning.
- **Freshness Cue** - Bright, consistent color reassures consumers of product freshness, while darkening can signal oxidation or staling.
- **Flavor Association** - Even browning signals proper roasting, enhancing consumer expectations of taste.



- **Coating Uniformity** – For seasoned or candied nuts, color reflects even application of coatings, sugar, or spices.

Challenges in Nut Color Consistency

- **Natural Variability** – Different origins, harvests, and varieties produce baseline differences in raw nut color.
- **Roasting Process Control** – Small changes in temperature, time, or airflow cause noticeable shifts in appearance.
- **Surface Irregularities** – Nuts have uneven surfaces, making visual inspection unreliable.
- **Subjectivity in Visual Checks** – Lighting and human perception inconsistencies reduce accuracy.

Why Instrumental Color Measurement is Essential

Spectrophotometry provides precise **CIELAB** values:

- **L*** – Measures lightness, directly tied to roast degree.
- **a*** – Measures red-green axis; higher a* often indicates deeper roasting.
- **b*** – Measures yellow-blue axis; higher b* can indicate lighter roasts or seasoning influence.

By using numerical targets and tolerances, manufacturers can:

- Quantify and standardize roast levels.
- Detect deviations before packaging.
- Maintain consistency across plants and global markets.

Recommended Solution – HunterLab Aeros



The **HunterLab Aeros** is ideally suited for nuts and roasted nut products:

- **Non-Contact Measurement** - Pours directly into the sample tray, no grinding or preparation required.
- **Large Area Capture (27.5 in², 35 readings in 5 seconds)** - Accurately averages across many nut pieces, reducing variability.
- **Automatic Rotation & Height Adjustment** - Ensures repeatable readings regardless of sample size or pile depth.
- **Integrated Touchscreen & Software** - Provides immediate pass/fail decisions and seamless data storage.

Benefits for Nut Manufacturers:

- Objective control of roast degree with L* values.
- Reliable detection of over- or under-roasted batches.
- Verification of coating uniformity on flavored or seasoned nuts.
- Reduced waste, rework, and consumer complaints.

Case Studies

Case Study 1 - Detecting Under-Roasting in Almonds

Background

A premium snack producer markets roasted almonds with a consistent golden-brown profile.

Challenge

The **Aeros** measured higher-than-standard L* values in a production batch, indicating lighter almonds than the brand specification. Consumers could perceive these as under-roasted and lacking flavors.



Corrective Action

- Oven dwell time was increased to achieve proper Maillard browning.
- An Aeros checkpoint was implemented post-roast to ensure target L* values were achieved before packaging.

Outcome

Color returned to target specifications, ensuring the almonds maintained their expected flavor and appearance.

Key Takeaway

L* values provide a reliable measure of roast degree, allowing manufacturers to correct process deviations quickly.

Case Study 2 – Preventing Over-Roasting in Cashews

Background

A company producing roasted cashews relies on uniform golden coloration as a marker of quality.

Challenge

The **Aeros** detected lower-than-standard L* values (darker cashews) in a production run. Investigation revealed the roasting temperature had drifted higher than setpoint, producing over-roasted product.

Corrective Action

- Oven controls were recalibrated to stabilize roasting conditions.
- Aeros readings were compared with stored standards to verify recovery to target values.



Outcome

The darker batch was contained before packaging, avoiding brand risk and consumer dissatisfaction.

Key Takeaway

Monitoring L* values with Aeros provides an early-warning system for over-roasting, preventing costly waste and protecting brand reputation.

Conclusion

Nuts and roasted nuts are high-value products where appearance directly reflects quality, freshness, and flavor expectations. Inconsistent color—whether from under-roasting, over-roasting, or uneven coating—can quickly erode consumer trust.

The **HunterLab Aeros spectrophotometer** provides the ideal solution for nut manufacturers, offering fast, non-contact, large-area measurement of heterogeneous samples. By using objective L*, a*, b* values, manufacturers can standardize roast levels, confirm coating uniformity, and deliver consistent product appearance worldwide.

With Aeros, nut producers can protect brand integrity, reduce waste, and ensure every package of nuts meets consumer expectations for quality and flavor