

A Statistical Sensory Best/Worst-Case Framework to Optimize DHA Product Design

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BACKGROUND

In consumer health and OTC product development, sensory performance strongly influences consumer acceptance and adherence.

Ingredients such as docosahexaenoic acid (DHA) present intrinsic sensory challenges — bitterness, rancidity, color, and persistent aftertaste.

These challenges often require product-specific masking strategies, increasing development time and laboratory testing.

OBJECTIVE

This study introduces a sensory-driven best/worst-case framework to define representative sensory boundaries for DHA oils.

The framework enables efficient early-stage decision-making and scalable sensory risk management across dosage forms and routes of administration.

We hypothesised that commercial DHA oils occupy a definable sensory space that can be bounded by a small number of representative best-case and worst-case materials.

If so, masking and mitigation strategies validated on those references can be extrapolated across the wider DHA portfolio.

MATERIALS & METHOD

METHOD AT A GLANCE

1. **9 commercial DHA oils**
   Triglyceride (TG), ethyl ester (EE) and algae-derived forms; low, medium and high concentration; alternative extraction processes
2. **Trained Expert DA Panel**
   12 trained assessors evaluated every oil undiluted
3. **Quantitative Descriptive Analysis**
   Appearance · aroma · taste · flavor · texture · mouthfeel · aftertaste persistence
4. **Temporal Assessment**
   Aftertaste persistence rated at 15 s, 1 min and 3 min post-consumption
5. **Statistical Analysis**
   ANOVA with LSD (Least Common Denominator) comparisons (90–95% confidence), PCA (Principal Component Analysis) and hierarchical clustering

RESULTS

Statistically significant discrimination among DHA oils was observed across multiple sensory attributes.

PCA revealed a structured sensory space: PC1 explained ~54% of variance, driven by overall flavor intensity, bitterness, rancid notes, and aftertaste persistence; PC2 (~27%) was associated with color intensity and viscosity.

Four reproducible sensory clusters spanning low- to high-impact profiles were identified (Figure 1).

Low-impact profiles showed reduced flavor intensity and shorter aftertaste; high-impact profiles exhibited pronounced bitterness, rancidity, darker color, and prolonged aftertaste.

Targeted statistical comparisons enabled further differentiation within clusters (Figure 2).

Figure 1. PCA and hierarchical clustering results

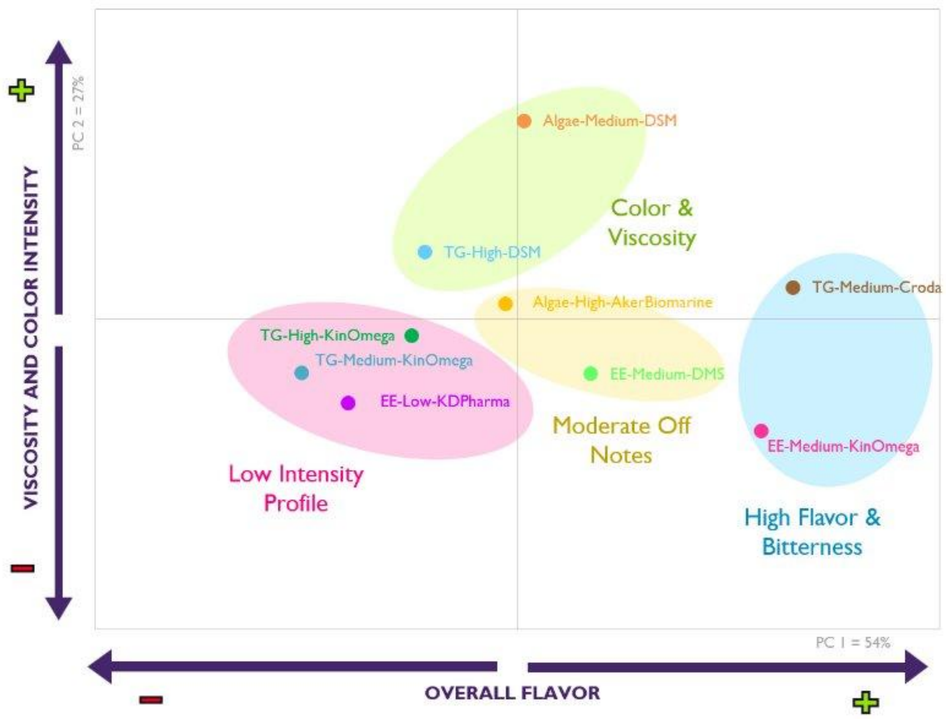


Figure 2. Line chart of each cluster identified: A) Low Intensity Profile; B) Color & Viscosity; C) Moderate Off Notes; D) High Flavor & Bitterness



CONCLUSIONS

This framework supports objective selection of best-case, worst-case, and optional intermediate references.

Validating sensory mitigation strategies on two to three representative materials enables extrapolation to any DHA within the defined chemical and compositional space, reducing formulation-specific sensory testing and shortening development timelines.

References: [1] Lawless HT., Heymann H. 2010. Sensory Evaluation of Food: Principles and Practices, 2nd ed. New York, NY: Chapman & Hall. [2] Stone H., Bleibaum R.N., Thomas H. 2012. Sensory Evaluation Practices, 4th ed. San Diego, CA: Elsevier Academic Press.