Descriptive Sensory Analysis: The Key to Understanding the Quality of Wheat Sourdough Bread

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Northwest Crops and Soils Program

"How can we use decades of private industry sensory knowledge to help farmers and local producers?"



### **Answer:**

# Use Descriptive Sensory Analysis (DSA) And

### **Decades of Interpretation Experience**

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#### 4 What is Descriptive Sensory Analysis (DSA)? How much do you like it? **Affective tests** 00 00 00 0 0 00 (Hedonic) **Difference tests** В Α Α **Flavor Profile - Bread Expert taster** 3 1 ½ Sweet **Toasted grain** 1 **Yeasty Sour** 1 1 ½ Astringent **Descriptive analysis** Dry 2 Salty 1

## The Flavor Profile Method of Sensory Analysis was developed by Arthur D. Little, Inc. (ADL) during the early 1940's.

First descriptive sensory method in the world to use highly trained people to objectively measure the sensory properties of food

- Qualitative and Quantitative
- Basis for descriptive testing done throughout the world today.

Introduced overall concept of Amplitude

- Balance
- Fullness

Standard Method (ASTM - E18)







Over decades of applied research, product development, and consumer insights revealed to ADL that perennial sales leaders in many categories had a set of descriptive sensory attributes in common. These five key sensory attributes are known as the Flavor Leadership Criteria.

	Flavor Leadership Criteria									
1	Aromatic Identity	<ul> <li>Immediate impact of identifying flavor</li> </ul>								
2	Amplitude	<ul> <li>Rapid development of balanced, full flavor</li> </ul>								
3	Mouthfeel	<ul> <li>Compatible mouthfeel factors</li> </ul>								
4	Off-notes	<ul> <li>No "off" flavors.</li> </ul>								
5	Aftertaste	<ul> <li>Short clean aftertaste</li> </ul>								

A properly trained DSA panel is the most sensitive instrument in the world. UVM Extension has a trained DSA panel that was used to generate the sensory data in this study.

- Individuals in the UVM Extension, Northwest Crops and Soils Program
- Formal Training Sessions
  - Food Products
  - Reference Standards
- Practice, practice, practice
- DSA panel work:
  - Grass-fed Milk
  - Artisan Cheese
  - Flint Corn
  - Hops and Beer





USDA NIFA OREI project Value-added Grains for Local and Regional Food Systems II

### The Northeast Winter Wheat Bake Trial – 2022

### Descriptive Sensory Analysis (DSA) Summary









## The UVM Extension DSA panel conducted an artisan bread sensory orientation session in February 2022

- A range of bread grain types were assessed using modified flavor profile
- The key, and differentiating, aroma, flavor, and texture attributes were identified
- An initial Profile Attribute Analysis (PAA) ballot was developed:
  - Results from the sensory orientation
  - Known success factors defined by the Flavor Leadership Criteria (FLC)
- Numerous practice PAA sessions were conducted on artisan bread



### The design for the northeast baking trial included:

#### Six coded samples of flour/bread:

- (Turkey Red) ERP
- IKR (Turkey Red)
- JXE (Warthog) ۲
- (Rouge de Bordeaux x Warthog) Red Hen PSJ ۲
- **XQM** (Maxine x Gua) ٠
- ZCL (Warthog x Gua) ٠

#### Two Vermont Bakeries\*:

- King Arthur
  - Jeffrey Hammelman
  - Carrie Brisson
- - *Randy George*

#### Two lots for DSA\*\*:

- Loaf A
- Loaf B





- The baking was done one week apart, with Red Hen baking the week of April 11<sup>th</sup> and King Arthur baking the week of April 18<sup>th</sup>, using a standard recipe and process
- \*\* DSA = Objective descriptive sensory analysis using a trained panel

The grain varieties were all grown in breeding trials (Julie Dawson and Lucia Gutierrez) in an on-farm trial with Meadowlark Organic (Ridgeway, WI), and then were milled by Meadowlark, so that all the samples were treated exactly the same. They represent crosses of historic winter wheat varieties known for artisanal bread making quality. For example:

<u>Warthog</u>: From Semican, a hard red winter wheat with excellent winter hardiness and good tolerance to FHB

**Rouge de Bordeaux**: An historic variety from France, popular in the 1800's, originally selected near Bordeaux from another variety, Noe, from the Odessa region of Ukraine

**Maxine:** From Ag Canada, a hard red winter wheat which has done well in organic systems in the Northeast

**<u>Gua</u>**: An historic variety that had done well in organic trials in France, it is early, productive, and resistant to lodging





<b>ATTRIBUT</b>	ΈS
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Total Intensity of Aroma	None <	Strong
Total Intensity of Flavor	None <	Strong
Balance	Unbalanced <	Balanced
Fullness	Thin <	Full
Grain Intensity	None <	Strong
Toasted Character	Raw <	Burnt
Sweet Aromatics	None <	Strong
Yeasty Aromatics	None <	Strong
Other Sour Aromatics	None <	Strong
Salt	None <	Strong
Sour	None <	Strong
Bitter	None <	Strong
Mouthfeel	None <	Strong
Others	None <	Strong
Aftertaste	None <	Strong

*SCALE* 1 2 3 4 5 6 7

> We used the objective Profile Attribute Analysis scoresheet presented in the sensory workshops to assess the samples blind, and in random order.

**Red** = FLC attributes

We included both texture attributes and impressions of flavor development.



**Red** = FLC attributes

The impressions of flavor development were added based on baker feedback as well as the Flavor Leadership Criteria (FLC).

We use the Arthur D. Little standard seven point intensity scale developed by MIT.

= None

1

2

3

4

5

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- = Very Slight
  - = Slight
  - = Slight to Moderate
  - = Moderate
  - = Moderate to Strong
  - = Strong



## The UVM Extension DSA panel generated extensive objective detailed sensory data on the bread samples. What do we do now?

Sample	TIA	TIF	BAL	FULL	GI	TOASTED	SWEETA	YEASTY	OTHSOUR	SALT	SOUR	BIT	MF	OTH	AFT
ERP	4.0	4.1	4.0	3.5	3.6	3.6	2.7	3.9	2.6	2.5	3.7	2.2	4.2	2.2	3.4
IKR	3.7	4.3	3.7	3.3	3.5	3.1	3.1	3.7	2.7	2.4	3.9	2.4	3.8	2.5	3.5
JXE	4.5	4.8	3.9	3.6	4.1	4.6	3.5	4.0	2.8	2.4	3.6	2.8	4.2	2.6	3.5
PSJ	3.8	4.4	3.9	3.4	3.7	4.3	2.7	4.0	2.5	2.4	3.4	2.4	3.8	2.4	3.4
XQM	4.3	4.7	4.0	3.8	3.8	4.2	3.4	4.1	2.4	2.5	3.8	2.7	4.5	2.9	3.7
ZCL	4.4	4.6	3.6	3.8	3.9	4.3	3.6	4.0	2.5	2.5	4.0	2.7	4.3	2.3	3.8

Sample	CR	DEN	MOIST	CHEW	CRUMB	First	FD
ERP	4.7	3.6	4.4	4.0	2.3	2.1	2.4
IKR	4.7	3.7	4.2	4.1	2.5	2.3	2.4
JXE	5.1	4.3	4.0	4.3	2.4	2.4	3.0
PSJ	4.9	3.4	4.1	3.9	2.3	2.0	2.2
XQM	5.0	4.1	4.1	4.5	2.4	2.1	2.8
ZCL	5.4	3.9	4.4	3.8	2.5	2.3	2.9

First, we can see some topline results such as samples ERP, IKR, and PSJ scored about the same on flavor and texture.

### Next, we see there were "meaningful" differences between the samples on a range of sensory attributes.

Sample	TIA	TIF	BAL	FULL	GI	TOASTED	SWEETA	YEASTY	OTHSOUR	SALT	SOUR	BIT	MF	OTH	AFT
ERP	4.0	4.1	4.0	3.5	3.6	3.6	2.7	3.9	2.6	2.5	3.7	2.2	4.2	2.2	3.4
IKR	3.7	4.3	3.7	3.3	3.5	3.1	3.1	3.7	2.7	2.4	3.9	2.4	3.8	2.5	3.5
JXE	4.5	4.8	3.9	3.6	4.1	4.6	3.5	4.0	2.8	2.4	3.6	2.8	4.2	2.6	3.5
PSJ	3.8	4.4	3.9	3.4	3.7	4.3	2.7	4.0	2.5	2.4	3.4	2.4	3.8	2.4	3.4
XQM	4.3	4.7	4.0	3.8	3.8	4.2	3.4	4.1	2.4	2.5	3.8	2.7	4.5	2.9	3.7
ZCL	4.4	4.6	3.6	3.8	3.9	4.3	3.6	4.0	2.5	2.5	4.0	2.7	4.3	2.3	3.8
Range	0.8	0.7	0.4	0.5	0.6	1.5	0.9	0.4	0.4	0.1	0.6	0.6	0.7	0.7	0.4

Sample	CR	DEN	MOIST	CHEW	CRUMB	First	FD
ERP	4.7	3.6	4.4	4.0	2.3	2.1	2.4
IKR	4.7	3.7	4.2	4.1	2.5	2.3	2.4
JXE	5.1	4.3	4.0	4.3	2.4	2.4	3.0
PSJ	4.9	3.4	4.1	3.9	2.3	2.0	2.2
XQM	5.0	4.1	4.1	4.5	2.4	2.1	2.8
ZCL	5.4	3.9	4.4	3.8	2.5	2.3	2.9
Range	0.7	0.9	0.4	0.7	0.2	0.4	0.8

Over decades of sensory research, ADL found that a >0.5 unit difference on a panel average for an attribute was "meaningful", or a difference large enough that an average person would not only notice the difference, but it would matter. *16* 

### Statistics help researchers. We typically use PCA Results to generate "Flavor Maps" to illustrate the results.

However, sensory differences between the samples was small and numerous dimensions were required to explain them.



	PC1	PC2	PC3	PC4
TIF	0.21	-0.14	0.1	-0.05
BAL	-0.05	0.02	-0.09	-0.15
FULL	0.26	0.02	0.03	0.04
GI	0.32	-0.19	-0.04	-0.16
TSD	0.4	-0.46	-0.5	-0.17
SWTA	0.44	0.14	0.26	-0.23
YEASTY	0.08	-0.1	-0.24	0.31
OTHSOUR	0.1	-0.31	0.34	0.09
SALT	0.12	-0.1	0.24	0.02
SOUR	0.11	-0.13	0.27	0.31
віт	0.27	-0.1	0.04	0.11
MF	0.2	0.23	-0.21	0.46
отн	0.25	-0.01	0.34	0.01
AFT	0.19	0.46	-0.08	0.17
CR	0.08	-0.03	-0.32	-0.1
DEN	0.26	0.35	0.11	-0.32
MOIST	-0.14	0.18	0.03	-0.42
CHEW	0.04	0.14	-0.1	0.12
CRUMB	0	-0.06	0.07	-0.1
FIRST	0.1	0.06	0.15	0.31
FD	0.28	0.34	-0.21	-0.05
СЛМ	0.32	0.47	0.58	0.67

## We generated flavor maps using the PCA results to illustrate the sensory results and check to make sure the sensory instrument (DSA Panel) is working.



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How can we interpret the data to provide useful information for you?

Arthur D. Little noted that over the decades of using DSA to understand the sensory properties of food products, two PCA indices always emerged that were most successful at describing the differences in products that matter to consumers, and predicted market performance.



These indices were always driven by the Flavor Leadership Criteria (FLC).

### We developed a quality index for bread using this past knowledge.

	From:	То:	Comment
Quality	Balanced (0.3) No mouthfeel (0.3) No others (0.3) No bitter (0.2) No aftertaste (0.3)	Not balanced Strong mouthfeel Strong others Strong bitter Strong aftertaste	Low numbers have higher quality and more liked by end users





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### We also developed an identity index for bread.

	From:	То:	Comment
	Thin (0.3) Slight grain (0.3)	Full bodied Strong grain	Need Consumer Information
Identity	Slight yeasty sour (0.3) Slight sour (0.3)	Strong yeasty sour Strong sour	
	Slight TIF (0.3)	Strong IIF	

These powerful indices summarize the core sensory properties of the bread samples that are known to result in people liking, or not liking them. They illustrate the information in a simple way to allow us to make quick decisions, and give immediate feedback.



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### **Overall Findings**

- Repeat bread samples produced using the Turkey Red wheat variety were not found to be different.
- The Rouge de Bordeaux x Warthog wheat variety produced bread with core sensory properties not different than the Turkey Red, and similar increased sensory quality
- The other wheat varieties, Warthog, Maxine x Gua, and Warthog x Gua, produced bread that had lower sensory quality.





### **Next Steps**

- We are currently finishing up a 2023 bake trial using the wheat varieties:
  - Rouge de Bordeaux x Warthog
  - Maxine x Gua
  - Rouge de Bordeaux x Araphahoe
  - Warthog Rep 1
  - Warthog Rep2
  - One baker Group for DSA King Arthur and Red Hen bakers at King Arthur Facility
  - UVM Extension DSA panel to generate the DSA data
- We will apply the same Quality and Identity indices to interpret the core data
- We will conduct hedonic (preference) tests with consumers of artisan whole grain breads to validate the Quality and Identity indices





We now have a quick and powerful DSA tool to evaluate research grains at an early stage to help make research decisions.

We intend to apply the same approach to other grains.

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# Thank you.

# **Questions?**

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