

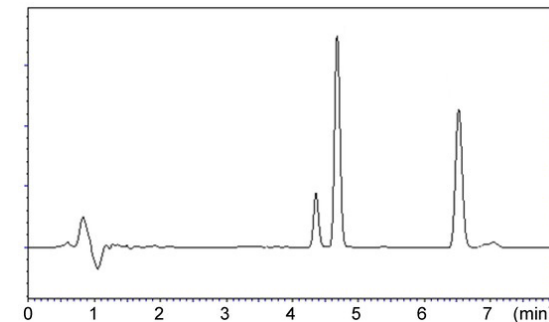
# Rethinking Heat: An Accuracy Update to the Scoville Heat Units (SHU) Methodology

ASTA Analytical Methods Subcommittee



# Scoville Heat Units

- Prior to 1995, the Scoville method was a sensory method.
- In 1995, ASTA and the AOAC collaborated to incorporate an instrumental method to calculate Scoville Heat Units (SHU) based on the research of Hoffman et al in 1983.
  - The Hoffman method:
    - Utilizes a HPLC with either a UV or fluorescence detector.
    - Uses N-vanillyl-n-nonanamide (NVN) as an external standard model.
    - Three main capsaicinoids for the Scoville Heat Unit (SHU) determination.
      - Nordihydrocapsaicin
      - Capsaicin
      - Dihydrocapsaicin
- Since 1995, ASTA 21.3 and AOAC 995.03 have been the standard for the determination of SHU.



# Scoville Heat Units Determination

- The procedure as developed involves a calculation based on the relative response factor of each capsaicinoid to NVM.

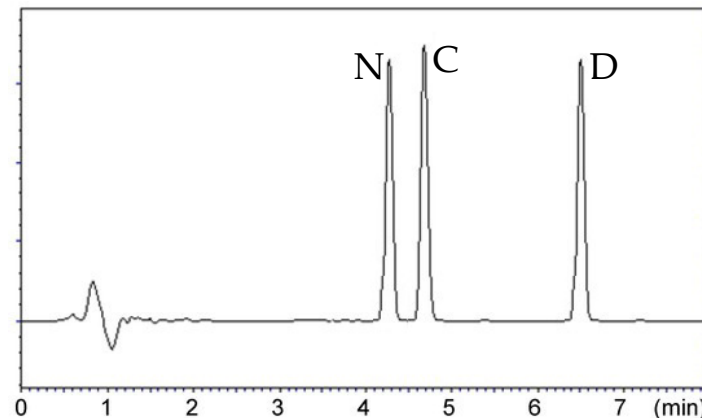
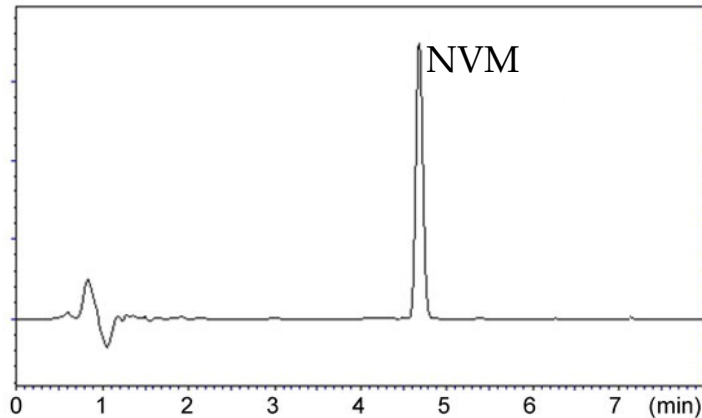
Scoville Heat Units (SHU) are the sum of SHU of the three major capsaicinoids.

Calculate SHU as follows:

- Nordihydrocapsaicin,  $SHU_N = (N/A) \times (C_s/C_x) \times (H_N/R_N)$ .
- Capsaicin,  $SHU_C = (C/A) \times (C_s/C_x) \times (H_C/R_C)$ .
- Dihydrocapsaicin,  $SHU_D = (D/A) \times (C_s/C_x) \times (H_D/R_D)$ .
- Total  $SHU_T = SHU_N + SHU_C + SHU_D$ .

Accepted heat factors and response factors:

		<u>UV</u>	<u>FLU</u>
Nordihydrocapsaicin (N)	- $H_N = 9.3 \times 10^6$	$R_N = 0.98$	0.92
Capsaicin (C)	- $H_C = 16.0 \times 10^6$	$R_C = 0.89$	0.88
Dihydrocapsaicin (D)	- $H_D = 16.0 \times 10^6$	$R_D = 0.93$	0.93
N-vanillyl-n-nonanamide		$R = 1.00$	1.00



# Call for Comments: Capsaicinoids in Capsicums (AOAC 995.03)

November 2021

- AOAC has issued a Call for Comments for the proposed modification of AOAC 995.03, Capsaicinoids in Capsicums and Their Extractives. AOAC is collecting comments on the proposal, including the rationale and proposed modification. Both the rationale to modify the method and the proposed modification are as follows:
- **Rationale:** “It is believed that the response factor for capsaicin by UV detection, as published in the method, is erroneous.”
- **Proposed Modification:** To address the error in response factor identified for capsaicin by UV detection, it is suggested to independently verify the response factors for all three capsaicinoids in the method using commercially available reference materials, both by UV and fluorescence detection



# ASTA Involvement

- Meetings with AOAC.
- Investigation on relative response factors.
- Evaluated alternative solutions for using NVM.
  - Collaborated with USP in making a single source commercially available standard.
- Wanted to ensure that technology did not change too much taking into consideration manufacturing plants, etc.



# ASTA SHU Investigation

- Five ASTA Laboratory Participants
  - Evaluated up to three Capsaicin sources (Two different Sigma part numbers and one USP).
  - Evaluated on C18 and Phenyl HPLC columns.
- Results
  - Mean Response Factor on the UV detector (n=13): 0.977
  - Mean Response Factor on the FLD detector (n=12): 0.960



# ASTA SHU Investigation

Calculate SHU as follows:

a) Nordihydrocapsaicin,  $SHU_N = (N/A) \times (C_s/C_x) \times (H_N/R_N)$ .

b) Capsaicin,  $SHU_C = (C/A) \times (C_s/C_x) \times (H_C/R_C)$  ← This value changes

c) Dihydrocapsaicin,  $SHU_D = (D/A) \times (C_s/C_x) \times (H_D/R_D)$ .

d) Total  $SHU_T = SHU_N + SHU_C + SHU_D$ .

- Capsaicin Response Factors

**ASTA 21.3 (2004) / AOAC 995.03**

Rc = 0.89 (UV) Rc = 0.88 (FLD)

**ASTA 21.3 (2026)**

Rc = 0.98 (UV) Rc = 0.96 (FLD)

## HPLC-FLD

### Sample

Sample #1  
Sample #2  
Sample #3  
Sample #4  
Sample #5  
Sample #6  
Sample #7  
Sample #8  
Sample #9

## Scoville Heat Units (SHU)

### ASTA 21.3 (2004)

1077  
5157  
228  
2663  
14053  
30583  
72164  
21885  
54523

### ASTA 21.3 (2026)

1018  
4904  
216  
2514  
13281  
28810  
67679  
20587  
51316

### %D

5.48  
4.90  
5.06  
5.61  
5.49  
5.80  
6.21  
5.93  
5.88



**Average**

**5.60**



## HPLC-UV

### Sample

Sample #10  
Sample #11  
Sample #12  
Sample #13

## Scoville Heat Units (SHU)

### ASTA 21.3 (2004)

1069  
5123  
226  
2643

### ASTA 21.3 (2026)

1005  
4847  
214  
2480

### %D

6.01  
5.38  
5.55  
6.16



**Average**

**5.78**



# What does this all mean?

Spice industry has been SHU database has been built over the last three decades.

Going Forward:

- ASTA Method 21.3 → ASTA Method 21.3 (2004)
  - Phase out in April 2031.
- ASTA Method 21.3 (2026)
- Scoville Heat Units
  - Product & Raw-Material Specifications
  - Product formulations
  - Certificates (COA's), Labels & Claims
  - Procurement - Commercial & Contractual Documents
  - Regulatory & Standards References
  - Food Safety & Quality Management System
  - Laboratory & Method-Control Documents



# Recipe's – No changes except Specifications



Parameter   Specification   Method of Analysis

Scoville   800-1200 SHU   ASTA 21.3 (2004)

Parameter   Specification   Method of Analysis

Scoville   754-1132 SHU   ASTA 21.3 (2026)



Both have the same taste



The ASTA Method 21.3 (2004) SHU can be estimated from the SHU as determined from ASTA Method 21.3 (2026) using the following equation:

$$\text{SHU}_{\text{ASTA Method 21.3 (2004)}} = \text{SHU}_{\text{ASTA Method 21.3 (2026)}} \times 0.9431$$

<b>SHU</b> <b><u>ASTA Method 21.3 (2004)</u></b>	<b>SHU</b> <b><u>ASTA Method 21.3 (2026)</u></b>	<b>Historical Variability of the Method</b>		
		<b><u>BIPEA PT</u></b>	<b><u># Participants</u></b>	<b>Variability</b> <b><u>+/- (%)</u></b>
27347	25791	November 2025	34	5.06
34314	32362	August 2025	35	6.64
70156	66164	May 2025	31	7.30
33490	31584	February 2025	28	6.55
13400	12638	September 2024	29	6.30
896	845	July 2024	32	7.19
2505	2362	May 2024	29	7.87
3312	3124			



# Frequently Asked Questions



- Why change at all?
- What are the downsides of not correcting this?
- Why not just keep the old method?
- How can we mitigate commercial impact?



- Potential reputational issues (analytical procedure is not truly accurate).
- Inconsistent / lack of alignment with other methods / standards.
- Liability
- Aid in providing a conversion factor so trade/business can continue on specifications developed using the old procedure.

