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

ASTA Analytical Methods Subcommittee

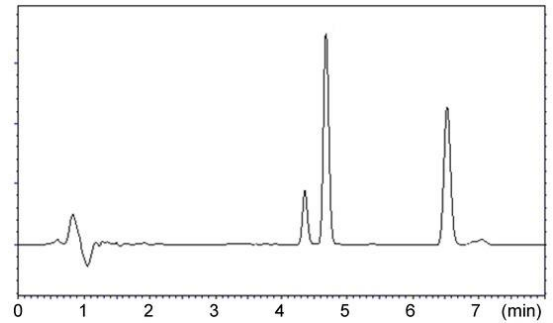
Scoville Heat Units

- 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

      Dihydrocapssaicin
- Since 1995, ASTA 21.3 and AOAC 995.03 have been the standard for the determination of SHU.



Scoville Heat Units Determination

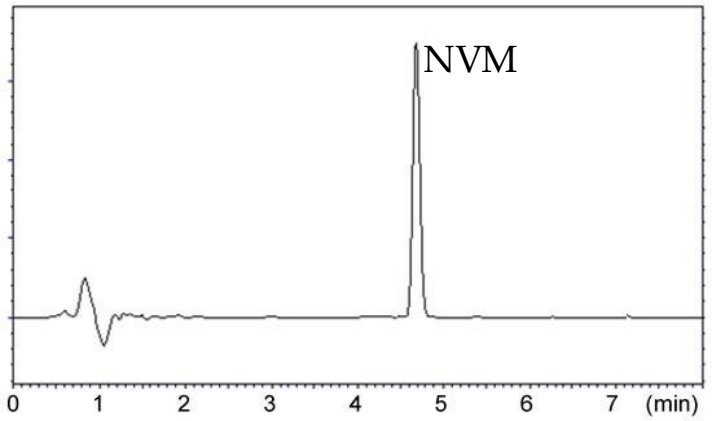
- The procedure as developed involves a calculation based on the relative response factor of each capsaicinoid to NVM.

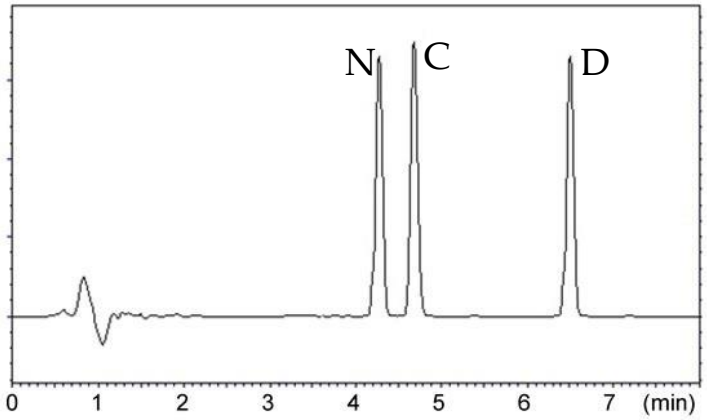
Scoville Heat Units (SHU) are the sum of SHU of the three major capsaicinoids. Calculate SHU as follows:

a) Nordihydrocapsaicin, $SHU_N = (N/A) \times (Cs/C_X) \times (H_N/R_N)$.
b) Capsaicin, $SHU_C = (C/A) \times (Cs/C_X) \times (H_C/R_C)$.
c) Dihydrocapsaicin, $SHU_D = (D/A) \times (Cs/C_X) \times (H_D/R_D)$.
d) Total $SHU_T = SHU_N + SHU_C + SHU_D$.

Accepted heat factors and response factors:

		UV	FLU
Nordihydrocapsaicin (N)	- H_N = 9.3 x 10^6	R_N = 0.98	0.92
Capsaicin (C)	- H_C = 16.0 x 10^6	R_C = 0.89	0.88
Dihydrocapsaicin (D)	- H_D = 16.0 x 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, $SHU_N = (N/A) \times (Cs/C_X) \times (H_N/R_N)$.

b) Capsaicin, $SHU_C = (C/A) \times (Cs/C_X) \times (H_C/R_C)$.

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

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

This value changes

- 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	Scoville Heat Units (SHU)			
Sample	ASTA 21.3 (2004)	ASTA 21.3 (2026)	%D	
Sample #1	1077	1018	5.48	↓
Sample #2	5157	4904	4.90	↓
Sample #3	228	216	5.06	↓
Sample #4	2663	2514	5.61	↓
Sample #5	14053	13281	5.49	↓
Sample #6	30583	28810	5.80	↓
Sample #7	72164	67679	6.21	↓
Sample #8	21885	20587	5.93	↓
Sample #9	54523	51316	5.88	↓
		Average	5.60	↓

HPLC-UV	Scoville Heat Units (SHU)			
Sample	ASTA 21.3 (2004)	ASTA 21.3 (2026)	%D	
Sample #10	1069	1005	6.01	↓
Sample #11	5123	4847	5.38	↓
Sample #12	226	214	5.55	↓
Sample #13	2643	2480	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)

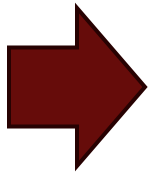
Parameter	Specification	Method of Analysis
Scoville	754-1132 SHU	ASTA 21.3 (2026)

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:

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

SHU ASTA Method 21.3 (2004)	SHU ASTA Method 21.3 (2026)
27347	25791
34314	32362
70156	66164
33490	31584
13400	12638
896	845
2505	2362
3312	3124



Historical Variability of the Method

BIPEA PT	# Participants	Variability +/- (%)
November 2025	34	5.06
August 2025	35	6.64
May 2025	31	7.30
February 2025	28	6.55
September 2024	29	6.30
July 2024	32	7.19
May 2024	29	7.87

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.