AOAC SMPR 2021.XXX; Draft AOAC Standard Method Performance Requirements (SMPRs) for Non-Targeted Testing (NTT) of Ingredients for Food Authenticity Methods Evaluation of Turmeric Spice Powder

Intended Use

AOAC SMPRs describe the minimum recommended performance characteristics to be used during the evaluation of a method. The evaluation may be an on-site verification, a single-laboratory validation, or a multi-site collaborative study. SMPRs are written and adopted by AOAC stakeholder panels composed of representatives from the industry, regulatory organizations, contract laboratories, test kit manufacturers, and academic institutions. AOAC SMPRs are used by AOAC expert review panels in their evaluation of validation study data for method being considered for *Performance Tested MethodsSM* or AOAC *Official Methods of Analysis*^{SM}, and can be used as acceptance criteria for verification at user laboratories.

1. Applicability

This document contains assessment parameters on the performance of Non-Targeted Testing methods to monitor the powdered form of turmeric spice powder for the probable presence of Economically Motivated Adulterants (EMA).

This SMPR was designed to evaluate Non-Targeted Testing (NTT) methods developed to assess potential economic adulteration in turmeric spice powder. The SMPR was purposely designed with general descriptions to be applicable to a broad range of innovative analytical platforms and chemometric approaches. Binary analytical results of "Authentic" or "Not Authentic" on defined samples from the performance of the method will be used to perform the evaluations by the Expert Review Panel.

Complete documentation of the collection and use of authentic samples is to be supplied by the method authors. The scope of authentic samples will be the applicable scope of the NTT method and expansion of the scope is possible with the inclusion of additional authentic samples into the baseline calibration, and validation using the protocol listed in this SMPR.

2. Analytical Technique

A non-targeted method to be used to evaluate foods and ingredients for possible EMAs. Any method generating a baseline fingerprint of the authentic material and comparing test sample fingerprints to assess differences will be considered. The final binary result identifies test samples as either authentic or potentially adulterated. This method demonstrates reliability using the requirements listed in this SMPR.

For single lab validation studies, the method will be evaluated using prescribed adulterated materials as shown in Table 1a and 1b. Methods approved at this level will proceed to a second level of evaluation (i.e., multi-laboratory validation) where blinded samples containing unknown adulterants will be sent to laboratories participating in the ensuing multi-laboratory validation.

The scope of the NTT method will be defined by the authentic samples used in generating the baseline fingerprint.

3. Definitions

Applicability Statement – a general statement about the intended purpose and scope of the method entailing key aspects of expected achievements for the specific situation and circumstances. Key

points to cover are the intended matrix scope, the purpose, and an indication of sensitivity, specificity, and significance (USP Appendix XVIII).

Authentic Samples – Samples representative of the genuine commodity. These samples should represent the food's or ingredient's variability seen naturally in the commodity. The authentic samples used to generate the product fingerprint will be used to properly define the NTT method testing scope.

Baseline Fingerprint – A food-specific model created by software evaluation of collected analytical data.

Economically Motivated Adulteration – The fraudulent addition of non-authentic substances or removal or replacement of authentic substances without the purchaser's knowledge for economic gain of the seller (USP Appendix XVIII).

Turmeric – For this SMPR, "turmeric" is defined as the spice powder obtained from *Curcuma longa* L., aka *Curcuma domestica, belonging to the b*otanical family: Zingiberaceae.

The accepted Latin binomial name is *Curcuma longa* L., and the synonymous name *Curcuma domestica, belonging to the b*otanical family: Zingiberaceae. It goes by the common names: Turmeric, common turmeric, Indian saffron, yellow ginger and the plant is native to Southeast Asia, especially India. It is available in all states of India, but particularly in Tamil Nadu, West Bengal, and Maharashtra. It is a tropical crop cultivated at sea level to 1,200 meters above sea level and grows in light black clay loam soils and red soils under irrigated and rain-fed conditions. It is also extensively cultivated in Pakistan, China, Haiti, Jamaica, Peru, Taiwan, Nigeria, Bangladesh, and Thailand. Other important producers include Japan, Indonesia, Sri Lanka, Burma (Myanmar), Cambodia, Malaysia, and the Philippines. It has a wide distribution as a non-native species in Madagascar, Oceania,

Turmeric is distinguished by the presence of the orange pigment curcumin. Several other species of *Curcuma*, e.g., *C. aromatica* and *C. zedoaria,* are also known to contain curcumin.

In terms of varieties, it appears there are up to 30 different varieties growing in India, but only two designations are commercially significant: *Alleppey* and *Madras* turmeric, both named after the places of cultivation. The *Alleppey* turmeric grows in the Thodupuzha and Muvattupuzha regions of Kerala State, and this variety is predominantly imported by the United States in unpolished form, where users prefer it as a spice and a food colorant. This turmeric contains about 3.5-5.5% volatile oil, and 4-7% curcumin. In contrast, the *Madras*-type contains only 2% of volatile oil and 2% of curcumin. The *Madras* turmeric is comprised of as many as nine cultivars, including *Guntur*, *Salem*, *Rajamundry*, *Nizamabad*, and *Cuddappah*. The British and Middle Eastern markets prefer the Madras turmeric for its more intense, brighter, and lighter yellow color, and because it is better suited for the mustard paste and curry powder or paste used in oriental dishes.

Single Laboratory Validation – Demonstration by one laboratory of method performance on samples described in Tables 1a and 1b. Methods may be validated using samples described in one or both tables. The applied table(s) will be used to define the scope of the analytical method.

Multilaboratory Validation – Demonstration between laboratories using adulterated samples created by a third-party group and supplied blindly to the participating laboratories.

Mentanil Yellow – sodium 3-[4-anilinophenylazo] benzenesulfonate

Orange II – sodium 4-[(2*E*)-2-(2-oxonaphthalen-1-ylidene) hydrazinyl] benzenesulfonate

4. Method Performance Requirements

Methods may be validated using the samples described in one or both of the following tables (Table 1a *Colorants*, Table 1b *Other Plants*). The applied table will be used to define the scope of the analytical method.

Table 1a: Method Performance Requirements for Turmeric Adulterated with Colorants

Test	Adulterant	% Adulterant in Test Materials	Number of Samples to be Tested[1]	Number of Test Results Qualified as Adulterated
Baseline	None (Authentic Turmeric)	0%	Establish Baseline Fingerprint[2]	
Validation using Authentic Samples[3]	None	0%	30	0
Validation[4]	Sudan 1	1 ppm	30	30
Validation[4]	Mentanil Yellow	1 ppm	30	30
Validation[4]	Orange II	1 ppm	30	30
Validation[4]	Lead Chromate	1 ppm	30	30
Validation[4]	Yellow Chalk (soapstone) powder	10%	30	30

1. Multiple samples from the same batch of adulterated material can be used for method evaluation.
2. Full details on protocol used to establish an authentic fingerprint must be supplied.
3. Samples used for this step must be independent than those used to create the baseline and must cover the entire scope of the method.
4. Method validation using adulterated samples shall cover the entire scope used in creating the baseline fingerprint.

Table 1b: Method Performance Requirements for Turmeric Adulterated with Other Plants

Test	Adulterant	% Adulterant in Test Materials	Number of Samples to be Tested[1]	Number of Test Results Qualified as Adulterated
Baseline	None (Authentic Turmeric)	0%	Establish Baseline Fingerprint[2]	
Validation using Authentic Samples[3]	None	0%	30	0
Validation[4]	*Curcuma xanthorrhoea*	10%	30	30
Validation[4]	*Curcuma zedoaria, Curcuma zedoaria*	10%	30	30

Validation[4]	*Curcuma malabarica*	10%	30	30
Validation[4]	*Curcuma aromatica*	10%	30	30
Validation[4]	*Cassava (Manihot esculenta)*	10%	30	30

1. Multiple samples from the same batch of adulterated material can be used for method evaluation.
2. Full details on protocol used to establish an authentic fingerprint must be supplied.
3. Samples used for this step must be independent than those used to create the baseline and must cover the entire scope of the method.
4. Method validation using adulterated samples shall cover the entire scope used in creating the baseline fingerprint.

5. System Suitability Tests and/or Analytical Quality Control

Suitable methods will include blanks, and appropriate check standards.

6. Reference Materials

Detailed protocols used to identify reference materials as authentic and to create adulterated samples must be supplied.

7. Validation Guidance

a) Data demonstrating method performance is required.

b) Available guidance documents:

a. AOAC INTERNATIONAL Guidelines for Validation of Botanical Identification Methods, Journal of AOAC International Vol. 95, No. 1, 2012

b. Statistical analysis of interlaboratory studies. LII. Sample size needed to meet performance requirement on proportion. http://lcfltd.com/AOAC/tr347-SAIS-LII-sample-size-needed-for-PR-for-proportion.pdf

c. United States Pharmacopeia (USP). Appendix XVIII: Guidance on Developing and Validating Non-targeted Methods for Adulteration Detection. Food Chemicals Codex, 3rd supplement to 11th ed.; USP: Rockville, MD, 2019

8. Maximum Time-to-Results

None.