AOAC Standard Method Performance requirements 2019.XX, Version 6; February 11, 2020.

Method Name: Detection of *Salmonella* species in Cannabis and Cannabis Products

Purpose: AOAC SMPRs describe the minimum recommended performance characteristics and suggested inclusivity/exclusivity organisms 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 methods being considered for *Performance Tested Methods* or AOAC *Official Methods of Analysis*, and can be used as acceptance criteria for verification at user laboratories.

Approved Body: AOAC Cannabis Analytical Science Program
Approval Date:
Final version date:

1. **Intended Use**: Consensus-based Reference method.

2. **Applicability:** Alternative methods used to detect *Salmonella* species and their serovars in cannabis and cannabis products.

3. **Analytical Technique**: Any analytical technique that can meet the requirements.

4. **Definitions**:

Candidate Method.— The method submitted for validation [Appendix J: *AOAC INTERNATIONAL Methods Committee Guidelines for Validation of Microbiological Methods for Food and Environmental Surfaces*, *Official Methods of Analysis of AOAC INTERNATIONAL*, (2019) 21st Ed., AOAC INTERNATIONAL, Rockville, MD, USA]

Candidate Method Presumptive Result.—Preliminary result for a test portion produced by following a candidate method's instructions for use.

Candidate Method Confirmed Result.—Final result obtained for a test portion after cultural confirmation of a candidate method.

Cannabis.—genus of flowering plants within the Cannabinaceae family that commonly contain 9-tetrahydrocannabinol (THC), cannabidiol (CBD), and other cannabinoids and terpenes. Cannabis includes, but is not limited to, high-THC and high-CBD cultivars.

Cannabis Concentrates.—Extracts (primarily composed of cannabinoids and/or terpenes) manufactured through the extraction and concentration of compounds derived from the cannabis plant or flower. Final products can be many forms including oils, wax, or hash (Category II).

Cannabis Infused Edibles.—Food and drinks containing extracts of cannabis and/or cannabis materials (Category III).

Cannabis Infused Non-Edibles.—Products containing extracts of cannabis and/or cannabis materials intended to be applied to the human body or any part thereof. Final products can be many forms including creams, ointments, cosmetics and therapeutic pads (Category IV).

Cannabis Plant and Flower.—General terms for the structural and flowering unadulterated parts of the cannabis plant (Category I).

Cannabis Products.—Products (edible and non-edible) extracted or infused with compounds derived from the cannabis plant including but not limited to CBD and THC.

Probability of detection (POD).—The portion of positive analytical outcomes for a qualitative method for a given matrix at a given analyte level or concentration. The difference in POD values between presumptive and confirmed results is termed $dPOD_{CP}$.

Exclusivity.—Study involving pure nontarget strains, which are potentially cross-reactive, that shall be not detected or enumerated by the candidate method. *See* Table 10 for a list of recommended nontarget strains. [Appendix J: *AOAC INTERNATIONAL Methods Committee Guidelines for Validation of Microbiological Methods for Food and Environmental Surfaces*, *Official Methods of Analysis of AOAC INTERNATIONAL*, (2019) 21st Ed., AOAC INTERNATIONAL, Rockville, MD, USA]

Fractional positive.—Validation criterion that is satisfied when an unknown sample yields both positive and negative responses within a set of replicate analyses. The proportion of positive responses should fall within 25 and 75% and should ideally approximate 50% of the total number of replicates in the set. A set of replicate analyses are those replicates analyzed by one method. Only one set of replicates per matrix is required to satisfy this criterion.

Inclusivity.—Study involving pure target strains that shall be detected or enumerated by the candidate method. *See* Tables 8 and 9 for a list of recommended target strains. [Appendix J: *AOAC INTERNATIONAL Methods Committee Guidelines for Validation of Microbiological Methods for Food and Environmental Surfaces*, *Official Methods of Analysis of AOAC INTERNATIONAL*, (2019) 21st Ed., AOAC INTERNATIONAL, Rockville, MD, USA]

Laboratory probability of detection (LPOD).—The POD value obtained from combining all valid collaborator data sets for a method for a given matrix at a given analyte level or concentration. [Appendix H: *Probability of Detection (POD) as a Statistical Model for the Validation of Qualitative Methods*, *Official Methods of Analysis of AOAC INTERNATIONAL*, (2019) 21st Ed., AOAC INTERNATIONAL, Rockville, MD, USA]

LCL.—Lower confidence limit.

Salmonella
Straight rods, 0.7 – 1.5 x 2-5 µm. Gram negative. Usually motile by peritrichous flagella. Facultative anaerobic. Chemoorganotrophic, having both a respiratory and fermentative metabolism. D-glucose and other carbohydrates are catabolized with the production of acid and usually gas. Oxidase negative, catalase positive, indole and Voges-Proskauer negative, methyl red and Simmons citrate positive. Lysine and ornithine decarboxylase positive, there is a variable arginine dihydrolase reaction. H_2S is produced, urea is not hydrolyzed, and growth on KCN and utilization of malonate are variable. Reduce nitrates. Carbohydrates usually fermented include L-arabinose, maltose, D-mannitol, D-mannose, L-rhamnose, D-sorbitol, trehalose, and D-xylose. Occur in humans, warm and cold blooded animals, food, and the environment. Pathogenic for humans and many animal species. Causative agent of typhoid fever, enteric fevers, gastroenteritis, and septicemia.[1]

Test portion.—The test portion is the sample size used in most validation studies. For cannabis flower/plant and cannabis infused non-edible products a 10 g test portion is used. For cannabis concentrates, a 5 g test portion is used. For cannabis infused edibles, a 25 g test portion is used. A larger test portion can be used in validation studies when appropriate. See Table 2 for minimum test portion requirements.

UCL. —Upper confidence limit.

5. System suitability tests and/or analytical quality control:
Positive and negative controls shall be embedded in assays as appropriate. Inhibition controls should be used for method verification for each new matrix. Manufacturer must provide written justification if controls are not appropriate to an assay.

6. Reference Material(s):
The use of live cultures and/or fungal spores (liquid stressed/non-stressed, lyophilized) is required for inclusivity and exclusivity testing and for inoculation of test matrices during the matrix studies. Extracted DNA is not suitable for use in validating methods against this SMPR but may be used to develop supplemental information.

7. Validation Guidance:

Appendix F: Guidelines for Standard Method Performance Requirements; 19th Edition of the AOAC INTERNATIONAL Official Methods of Analysis (2012). Available at: http://www.eoma.aoac.org/app_f.pdf

Appendix J: *AOAC INTERNATIONAL Methods Committee Guidelines for Validation of Microbiological Methods for Food and Environmental Surfaces* [*Official Methods of Analysis of AOAC INTERNATIONAL* (2019) 21st Ed., AOAC INTERNATIONAL, Rockville, MD, USA]; or ISO 16140-2:2016.

United States Pharmacopeia. Microbiological Examination of Nonsterile Products: Microbial Enumeration Tests (61), USP 40. *United States Pharmacopeia.*

[1] Bergey's Manual of Determinative Bacteriology Ninth edition edited by John G. Holt.

United States Pharmacopeia. Microbiological Examination of Nonsterile Products: Tests for Specified Microorganisms (62), USP 40. *United States Pharmacopeia.* Feng, P., Weagant, S.D., Grant, M.A., Burkhardt, W. (2017)

Bacteriological Analytical Manual:
Chapter 4 Enumeration of Escherichia coli and the Coliform Bacteria
https://www.fda.gov/Food/FoodScienceResearch/LaboratoryMethods/ucm064948.htm
Andrews, W. H., Wang, H., Jacobson, A., Hammack, T. (2018) *Bacteriological Analytical Manual Chapter 5: Salmonella*
https://www.fda.gov/Food/FoodScienceResearch/LaboratoryMethods/ucm070149.htm

At the time of the publication, no national reference method exists for the confirmation of *Salmonella spp.* from cannabis products. Until a suitable reference method is established the following is recommended for method developers:

To screen samples for the presence or absence of the target analyte, two methods that employ different technologies (agar plate, PCR, ELISA) must be used.

To ensure the viability of the inoculating organism (both confirming presumptive results or determining false negative results) a secondary enrichment followed by plating of the sample to a minimum of two types of agar plates, one of which is recommended to be chromogenic agar, is required (Table 6). Final confirmation can be achieved via matrix assisted laser desorption/ionization time of flight (MALDI-TOF) mass spectroscopy, sequencing, or other suitable confirmatory procedures (e.g., biochemical analysis).

When performing the validation, bulk inoculation of test material is required. In certain instances (e.g., therapeutic patches) individual item inoculation may be required.

For the Single Laboratory Validation with artificial contamination, matrix naturally contaminated with non-target organisms (when available) shall be used. For at least one matrix evaluated during the single laboratory validation, competing non-target microflora must be at least 10x the level of the target microorganism. If the concentration of competing microflora does not exceed 10x the target organism for any matrix, artificial contamination of one matrix with non-target organism(s) is required.

A minimum three level most probable number (MPN) study should be performed to determine the concentration of the target organism used in the validation. If possible, the use of test portions included in the matrix study should be included as a level in the MPN study. See AOAC Appendix J guidelines for details on performing the MPN study.

8. Maximum Time-To-Determination: None

9. Method Performance Requirements

See Table 1 for acceptance criteria for validation
See Table 2 for category test portion requirement
See Table 3 for matrix claims acceptance criteria
See Table 4 for descriptions of MPN analysis
See Table 5 condition of inoculating culture and stabilization of matrix for inoculation
See Table 6 for selective broth and agar recommendations
See Table 7 for inclusivity and exclusivity performance requirements
See Tables 8 & 9 for inclusivity organisms
See Table 10 for exclusivity organisms

Table 1. Validation Acceptance Criteria (Plants/Flowers, Concentrates, Infused Edibles, Infused Non-Edibles)

Parameter	Parameter Requirements	Target Test Concentration[a]	Minimum Acceptable Results
Single Laboratory Validation with artificial contamination			
Fractional Concentration (low level)	Replicates per matrix: 20 Inoculation procedure: AOAC Appendix J	Low level to produce fractional positive results Ex. 0.2-2 CFU/Test Portion	Fractional positive results, 25-75% (5-15 positive test replicates) $dPOD_{CP}$ 95% CI: LCL < 0 < UCL[b]
High Concentration	Replicates: 5 Inoculation procedure: AOAC Appendix J	High level to produce consistently positive results Ex. 2-10 CFU/Test Portion	POD of 1.00[c]
Non-Inoculated (Zero) concentration	Replicates: 5	0 CFU/Test Portion	POD of 0.00[c]
Single Laboratory Validation with natural contamination			
Acceptable minimum detection level (low level)	2 separate lots of 20 replicates	N/A	Fractional positive results, 25-75% (5-15 positive test replicates) for minimum 1 lot $dPOD_{CP}$ 95% CI: LCL < 0 < UCL[b]
Multi Laboratory Validation			
LPOD	12	1-10 CFU/Test Portion	0.15 ≥ LPOD ≥ 0.85 $dPOD_{CP}$ 95% CI: LCL < 0 < UCL[b]
	12	10-50 CFU/ Test Portion	LPOD ≥ 0.95
$LPOD_{(0)}$	12	0 CFU/Test Portion	LPOD ≤ 0.05
[a]Determined through MPN Procedures (see Table 4)			
[b]The range between the lower and upper confidence interval should encompass 0, if not, the results must be investigated, and an explanation provided.			
[c]If acceptance criteria is not observed, results must be investigated, and an explanation provided			

Table 2. Category Test Portion Requirements

Category	Minimum Test Portion Size[a]
Plants & Flowers	10 g
Concentrates	5 g
Infused Edibles	25 g
Infused Non-Edibles	10 g
[a]Minimum test portion size required for validation. Alternatively, larger test portions may be validated.	

Table 3. Acceptable Matrix Claims

Matrix Claim	Criteria	
	Number of Matrices	Minimum Number of Categories
Broad Range of Cannabis & Cannabis Products	15 (minimum 3 matrices/category)	4 categories
Variety of Cannabis & Cannabis Products	≥ 10 (minimum 2 matrices/category)	4 categories
Select Cannabis Products	≥ 5	2 categories
Specific Category	≥ 5	1 category
Specific Matrix (s)	≥ 1	1 category

RE: AOAC Technical Bulletin: TB02MAY2016: Acceptable Validation Claims for Proprietary/Commercial Microbiology Methods for Foods and Environmental Surfaces.

Table 4. Minimum Most Probable (MPN) Number Recommendation

Category	Inoculation Level	Large Test Portions	Medium Test Portions	Small Test Portions
Plants & Flowers Concentrates	Low	20 x 10 g*	3 x 5 g	3 x 1 g
	High	5 x 10 g*	3 x 5 g	3 x 1 g
Concentrates	Low	20 x 5 g	3 x 2.5 g	3 x 1 g
	High	5 x 5 g*	3 x 2.5 g	3 x 1 g
Infused Edibles	Low	20 x 25 g*	3 x 10 g	3 x 5 g
	High	5 x 25 g*	3 x 10 g	3 x 5 g
Infused Non-Edibles	Low	20 x 10 g*	3 x 5 g	3 x 1 g
	High	5 x 10 g*	3 x 5 g	3 x 1 g

*Test portions from matrix study

Table 5. Condition of Inoculating Culture and Stabilization of Matrix

Matrix	Inoculating Cells	Stabilization Conditions
Perishable product	Liquid non-stressed culture	4°C, 48-72 h
Heat processed perishable product	Liquid heat stressed	4°C, 48-72 h
Frozen Product	Liquid non-stressed culture (If frozen food is processed, cells must be heat stressed)	-20°C, 2 weeks
Shelf stable dry product	Dried culture	Ambient Temperature (20-25°C), 2 weeks
Shelf stable liquid product (heat processed)	Liquid non-stressed culture (If shelf stable product is processed, cells must be heat stressed)	Ambient Temperature (20-25°C), 2 weeks

Table 6: Recommended Selective Broths and Agars

Media Name	Media Type
Rappaport-Vassiliadis (RV) (alternately Rappaport-Vassiliadis R10)	Broth
Tetrathionate (TT)	Broth
Selenite cysteine (SC)	Broth
Xylose lysine desoxycholate (XLD)	Agar
Hektoen enteric (HE)	Agar
Bismuth sulfite (BS)	Agar
Chromogenic *Salmonella*	Agar
MacConkey	Agar

Table 7. Inclusivity/Exclusivity Performance Requirements

Parameter	Parameter Requirements	Final Test Concentration (CFU/mL)	Minimum Acceptable Results
Inclusivity	Single-laboratory validation (SLV) study: At least 10 strains per required *Salmonella spp.* (reference Annex I) cultured by the candidate method enrichment procedure. A minimum of 100 strains is required (including those detailed in Table 8).	10-100 x limit of detection of the candidate method	100% positive results[a]
Exclusivity	SLV study: At least 30 non-target organisms, cultured under optimal conditions for growth[b]	Overnight growth undiluted	100% negative results[a]

a 100% correct analyses are expected. All unexpected results are to be retested following internationally recognized guidelines (ISO 16140, AOAC OMA Appendix J, The Compendium of Analytical Methods of Health Canada). Some unexpected results may be acceptable if the unexpected results are investigated, and acceptable explanations can be determined and communicated to method users

b In instances where an exclusivity culture produces a positive result by the candidate method, the culture may be reanalyzed after culture following the candidate method enrichment procedure. Both results (optimal growth conditions and candidate method enrichment) must be reported.

Tables 8 & 9: Inclusivity Panel

The following are lists of required and suggested subspecies and serovars that method developers can use to validate their methods. It is recommended that method developers reference CDC's revised Atlas on Salmonella (https://www.cdc.gov/salmonella/pdf/salmonella-atlas-508c.pdf) to incorporate as many serovars listed therein as possible. A minimum of 100 serovars are required for AOAC adoption. Additionally, the requirements in Table 8 must be met.

Table 8: Required *Salmonella* subspecies for Inclusivity

	SALMONELLA	**Minimum Number of Serovars Included**
1	*Salmonella bongori*	2
2	*Salmonella enterica* subsp. *arizonae*	3
3	*Salmonella enterica* subsp. *diarizonae*	3
4	*Salmonella enterica* subsp. *houtenae*	3
5	*Salmonella enterica* subsp. *indica*	3
6	*Salmonella enterica* subsp. *salamae*	3
7	*Salmonella enterica* subsp. *enterica*	1 strain per serovar

Table 9: Suggested *Salmonella* serovars for Inclusivity

	SALMONELLA (serovar included)	Antigenic Properties SEROTYPE		Year OUTBREAK	Center for Disease Control and Prevention Top 20**	Food and Drug Adminstration Ranking Top 40
		O	H			
1	Salmonella bongori, Serotype Brookfield	66	z41:-			
2	Salmonella bongori	66				
3	Salmonella enterica subsp. Salamae	47				
4	Salmonella enterica subsp. Salamae	50				
5	Salmonella enterica subsp. salamae	53				
6	Salmonella enterica subsp. salamae	55				
7	Salmonella enterica subsp. salamae serovar Artis	56				
8	Salmonella enterica subsp. salamae	57				
9	Salmonella enterica subsp. salamae serovar Basel	58				
10	Salmonella enterica subsp. salamae	59				
11	Salmonella enterica subsp. salamae	60				
12	Salmonella enterica subsp. Arizonae#	40				41
13	Salmonella enterica subsp. Arizonae	51				
14	Salmonella enterica subsp. Arizonae	62				
15	Salmonella enterica subsp. Arizonae	63				
16	Salmonella enterica subsp. Arizonae	65				
17	Salmonella enterica subsp. diarizonae	35				
18	Salmonella enterica subsp. diarizonae	47				
19	Salmonella enterica subsp. Diarizonae#	48				29
20	Salmonella enterica subsp. diarizonae serovar Eilbek	61				
21	Salmonella enterica subsp. houtenae serovar Halmstad	3,{10}{15}{15,34}	g,s,t:-			

22	Salmonella enterica subsp. houtenae serovar Harmelen	51				
23	Salmonella enterica subsp. houtenae serovar Ochsenzoll	16				
24	Salmonella enterica subsp. Indica	1,6,14,25				
25	Salmonella enterica subsp. Indica	45				
26	Salmonella enterica subsp. enterica serovar Paratyphi A	1,2,12				
27	Salmonella enterica subsp. enterica serovar Agona#	1,4,[5],12	f,g,s:[1,2]	11	15	5
28	Salmonella enterica subsp. enterica serovar Heidelberg	1 ,4,[5],12	r:1,2	14, 13, 11	7	
29	Salmonella enterica subsp. enterica serovar Paratyphi B#	1,4,[5],12	b:1,2		16	34
30	Salmonella enterica subsp. enterica serovar Derby	1, 4,[5], 12	f,g:[1,2]			
31	Salmonella enterica subsp. enterica Typhimurium#	1,4 ,[5],12	i:1,2	13, 12, 11, 10	2	6
32	Salmonella enterica subsp. enterica serovar Saintpaul#	1,4,[5],12	e,h:1,2	13	12	15
33	Salmonella enterica subsp. enterica serovar Sandiego#	1,4,[5],12	e,h:e,n,z_{15}	13		24
34	Salmonella enterica subsp. enterica I 4,[5],12:i:-	1,4,[5],12	i:-	10	5	
35	Salmonella enterica subsp. enterica Chester	1,4,[5],12	e,h:e,n,x	10		
36	Salmonella enterica subsp. enterica Stanley*	1,4,[5],12,[27]	d:1,2	14		31
37	Salmonella enterica subsp. enterica serovar Indiana	1,4,12	z;1,7			
38	Salmonella enterica subsp. enterica serovar Preston	1,4,12	z:l,w			
39	Salmonella enterica subsp. enterica serovar Bredeney	1,4,12,27	l,v:1,7	12		
40	Salmonella enterica subsp. enterica Vellore	1,4,12,27	z_{10}:z_{35}			
41	Salmonella enterica subsp. enterica serovar Schwarzengrund	1 ,4 ,12, 27	d:1,7			
42	Salmonella enterica subsp. enterica serovar Abortusequi	4,12	-:e,n,x			
43	Salmonella enterica subsp. enterica serovar Abortusovis	4,12	c:1,6			
44	Salmonella enterica subsp. enterica	6, 7	c:1,5			

	serovar Choleraesuis					
45	Salmonella enterica subsp. enterica Hartford	6, 7	y:e,n,x	10		
46	Salmonella enterica subsp. enterica Braenderup #	6 , 7,14	This serovar is now recognized as Westhampton var 15+	12	10	40
47	Salmonella enterica subsp. enterica serovar Bareilly#	6,7,14	y:e,n,x	12	17	14
48	Salmonella enterica subsp. enterica serovar Infantis#	6,7,14	r:1,5	12	9	28
49	Salmonella enterica subsp. enterica serovar Lille	6,7,14	z_{38}:-	13,12		
50	Salmonella enterica subsp. enterica serovar Mbandaka#	6, 7, 14	z_{10}:e,n,z_{15}	13		2
51	Salmonella enterica subsp. enterica serovar Oranienburg#	6, 7, 14	m,t:[z_{57}]		11	10
52	Salmonella enterica subsp. enterica serovar Thompson#	6, 7, 14	K:1,5		14	19
53	Salmonella enterica subsp. enterica serovar Montevideo#	6 , 7,14,[54]	g,m,[p],s: [1,2,7]	13,12, 10	6	4
54	Salmonella enterica subsp. enterica serovar Hadar	6,8	z_{10}:e,n,x	12, 11		
55	Salmonella enterica subsp. enterica serovar Muenchen#	6, 8	d:1,2		8	12
56	Salmonella enterica subsp. enterica serovar Newport#	6, 8, 20	e,h:1,2	13,12, 10	3	1
57	Salmonella enterica subsp. enterica serovar Haardt	8	k:1,5			
58	Salmonella enterica subsp. enterica serovar Kentucky#	8, 20	l,z_6			18
59	Salmonella enterica subsp. enterica Panama#	1,9,12	l,v:1,5	11		39
60	Salmonella enterica subsp. enterica serovar Berta	1,9,12	[f],g,[t]:-		19	
61	Salmonella enterica subsp. enterica serovar Enteritidis#	1,9,12	g,m:-	12, 11, 10	1	17
62	Salmonella enterica subsp. enterica serovar Gallinarum	1,9,12	-:-			
63	Salmonella enterica subsp. enterica serovar Javiana#	1,9,12	l,z_{28}:1,5		4	13
64	Salmonella enterica subsp. enterica serovar Neasden	9,12	g,s,t:e,n,x			
65	Salmonella enterica subsp. enterica serovar Typhi	9,12[Vi]	d:-	10	18	

66	Salmonella enterica subsp. enterica Baildon	9,46	a:e,n,x	10		
67	Salmonella enterica subsp. enterica serovar Anatum[#]	3,{10}{15}{15,34}	e,h:1,6		20	8
68	Salmonella enterica subsp. enterica serovar Anatum var. 15+	3,{10}{15}	g,m,s:-			
69	Salmonella enterica subsp. enterica serovar Give[#]	3,{10}{15}{15,34}	l,v:1,7			11
70	Salmonella enterica subsp. enterica Nchanga	3 ,{10}{15}	l,v:1,2	12		
71	Salmonella enterica subsp. enterica serovar Krefeld	1,3,19	y;l,w			
72	Salmonella enterica subsp. enterica serovar Senftenberg[#]	1 ,3,19	g,[s],t:-			3
73	Salmonella enterica subsp. enterica serovar Abaetetuba[#]	11	k:1,5			38
74	Salmonella enterica subsp. enterica serovar Poona[#]	1,13,22	z:1,6	13		21
75	Salmonella enterica subsp. enterica Cubana[#]	1 ,13,23	z_{29}:-			27
76	Salmonella enterica subsp. enterica Mississippi	1 ,13,23	b:1,5		11	
77	Salmonella enterica subsp. enterica serovar Bristol	13,22	z:1,7			
78	Salmonella enterica subsp. enterica serovar Putten	13,23	d:l,w			
79	Salmonella enterica subsp. enterica serovar Kaitaan	1,6,14,25	m,t:-			
80	Salmonella enterica subsp. enterica serovar Schalkwijk	6 ,14,[24]	i:e,n,z_{15}			
81	Salmonella enterica subsp. enterica serovar Sundsvall	[1], 6,14,[25]	z:e.n.x			
82	Salmonella enterica subsp. enterica serovar Nottingham	16	d:e,n,z_{15}			
83	Salmonella enterica subsp. enterica serovar Matadi	17	k:e,n,x			
84	Salmonella enterica subsp. enterica serovar Cerro	6,14,18	z_4,z_{23}:[1,5]			
85	Salmonella enterica subsp. enterica serovar Minnesota	21	b:e,n,x			
86	Salmonella enterica subsp. enterica Pomona[#]	28	y:1,7	13		37
87	Salmonella enterica subsp. enterica Urbana[#]	30	b:e,n,x			33
88	Salmonella enterica subsp. enterica serovar Adelaide	35	f,g:-			
89	Salmonella enterica subsp. enterica serovar Inverness	38	k:1,6			

90	Salmonella enterica subsp. enterica serovar Champaign	39	k:1,5			
91	Salmonella enterica subsp. enterica serovar Johannesburg	1,40	b:e,n,x	11		
92	Salmonella enterica subsp. enterica serovar Waycross	41	z_4,z_{23}:[e,n,z_{15}]			
93	Salmonella enterica subsp. enterica serovar Kahla	1, 42	z_{35}:1,6			
94	Salmonella enterica subsp. enterica serovar Houten	43	z_4,z_{23}:-			
95	Salmonella enterica subsp. enterica serovar Niarembe	44	a:l,w			
96	Salmonella enterica subsp. enterica serovar Deversoir	45	c:e,n,x			
97	Salmonella enterica subsp. enterica serovar Dahlem	48	k:e,n,z_{15}			
98	Salmonella enterica subsp. enterica serovar Wassenaar	50				
99	Salmonella enterica subsp. enterica Utrecht	52	d:1,5			
100	Salmonella enterica subsp. enterica serovar Uccle	54	g,s,t:-			
101	Salmonella enterica subsp. enterica Tranora	55	k:z_{39}			
102	Salmonella enterica subsp. enterica serovar Crossness	67	r:1,2			
103	Salmonella enterica subsp. enterica serovar Weltevreden[#]	3 , {10}{15}	r:z_6			7
104	Salmonella enterica subsp. enterica serovar Tennessee[#]	6,7,14	z_{29}:[1,2,7]			9
105	Salmonella enterica subsp. enterica serovar Rubislaw[#]	11	r:e,n,x			16
106	Salmonella enterica subsp. enterica serovar Virchow[#]	6,7,14	r:1,2			20
107	Salmonella enterica subsp. enterica serovar Hvittingfoss[#]	16	b:e,n,x			22
108	Salmonella enterica subsp. enterica serovar Gaminara[#]	16	d:1,7			23
109	Salmonella enterica subsp. enterica serovar Aberdeen[#]	11	i:1,2			25
110	Salmonella enterica subsp. enterica serovar Mgulani	38	i:1,2			26
111	Salmonella enterica subsp. enterica serovar Havana[#]	1,13,23	f,g,[s]:-			30
112	Salmonella enterica subsp. enterica serovar Wandsworth[#]	39	b:1,2			32
113	Salmonella enterica subsp. enterica serovar Caracas[#]	[1],6,14,[25]	g,m,s:-			35

114	Salmonella enterica subsp. enterica serovar Rissen[#]	6,7,14	f,g:-			36
115	Salmonella enterica subsp. enterica serovar Michigan[#]	17	l,v:1,2			42
116	Salmonella enterica subsp. enterica serovar Meleagridis[#]	3,{10}{15}{15,34}	e,h;l,w			43

* Strains identified from outbreaks, shorten date as (2011 = "11"; 2012 = "12)

** Number indicates the numerical position on CDC list.

[#] Serotypes isolated from vegetable products, including spices. Courtesy of FDA-CFSAN

Table 10: Exclusivity Panel

Organism	
Aeromonas hydrophila	*Hafnia* species
Additional *Aeromonas species*	*Klebsiella oxytoca*
Burkholderia species	*Klebsiella pneumonia*
Bacillus subtilis	*Listeria monocytogenes*
Campylobacter jejuni	*Morganella morganii*
Candida tropicalis	*Pantoea species*
Citrobacter braakii	*Proteus hauseri*
Citrobacter farmerii	*Proteus mirabilis*
Citrobacter freundii	*Proteus vulgaris*
Citrobacter murliniae	*Pseudomonas aeruginosa*
Citrobacter youngae	*Pseudomonas fluorescens*
Citrobacter species	*Pseudomonas species*
Edwardsiella tarda	*Ralstonia species*
Enterobacter aerogenes	*Rhanella species*
Enterobacter amnigenus	*Serratia marcesens*
Enterobacter cancerogenus	*Shigella dysenteriae*
Enterobacter cloacae	*Shigella flexneri*
Enterobacter gergoviae	*Shigella sonnei*
Enterobacter sakazakii	*Trichoderma harzianum*
Erwinia species	*Yersinia* species
Escherichia coli	*Vibrio vulnificus*
Escherichia coli O157:H7	
Escherichia fergusonii	
Escherichia hermanii	
Escherichia vulneris	