Surveys for Foodborne Pathogens on Nuts: Tables and References

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* A previous version of this document is available on the website in the "Archived Documents, Nuts and Nut Pastes" folder.

Table 1. Prevalence of *Salmonella* on naturally contaminated nuts

Type of nut	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	No. positive for *Salmonella*	Percent positive (if *n*>50)	*Salmonella* serotype	References
Almond, raw kernel	Processor receiving, California	100	14,949	146	0.98 ± 0.29 (for 2001–07, 2010, and unpublished)	Enteritidis, Montevideo, Senftenberg, Thompson, Typhimurium, and 36 others	Bansal et al., 2010; Danyluk et al., 2007; Lambertini et al., 2012; Harris, unpublished [2013 data]; Santillana Farakos et al., 2017
Almond, raw (inshell)	Processor receiving, California	100	455	7	1.5 (for 2006–07)	Give, Muenchen, Newport, Thompson, Typhimurium, IIIa:18:z32	Bansal et al., 2010
Almond, raw kernel	Processor receiving, Australia	25	60	1	1.7	Fremantle subsp. II	Eglezos et al., 2008
Almond, treated	RTE packages at processor, Australia	25	42	0			Eglezos, 2010
Almond, roasted	Retail, UK	25	83	0	0		Little et al., 2009
Almond, treated (roasted and unknown)	Retail, UK	25	359	0	0		Little et al., 2010
Almond (packaged, unpackaged, and nut product)	Retail, manufacturers, and growers, Australia	25	131	0	0		NSW Food Authority, 2012
Almond, inshell	Retail, Canada	25	86	0	0		CFIA, 2017
Almond, shelled	Retail, Canada	25	319	0	0		CFIA, 2017

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Type of nut	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	No. positive for *Salmonella*	Percent positive (if *n*>50)	*Salmonella* serotype	References
Brazil nut, raw (shelled)	Retail, Brazil	not given	two 2-kg samples, subsample size not given	not given	not given	Typhimurium	Freire and Offord, 2002
Brazil nut, raw (inshell, shelled)	Processor	50	20	0			Arrus et al., 2005
Brazil nut, raw	Processor receiving, Australia	25	60	0	0		Eglezos et al., 2008
Brazil nut, raw (shelled)	Retail, US (prepacked, conventional and organically grown)	375	296	0	0		Zhang et al., 2021
Brazil nut, roasted	Retail, UK	25	218	0	0		Little et al., 2009
Brazil nut, treated	Retail, UK	25	469	2	0.4	Senftenberg, Tennessee	Little et al., 2010
Brazil nut, treated	RTE packages at processor, Australia	25	40	0			Eglezos, 2010
Brazil nut (packaged, unpackaged, and nut product)	Retail and manufacturers, Australia	25	62	0	0		NSW Food Authority, 2012
Brazil nut, inshell	Retail, Canada	25	7	0			CFIA, 2017
Brazil nut, shelled	Retail, Canada	25	67	0	0		CFIA, 2017
Cashew, raw	Processor receiving, Australia	25	100	0	0		Eglezos et al., 2008
Cashew, raw (shelled)	Retail, US (prepacked, conventional and organically grown)	375	733	4	0.55	Brunei, Give, Nima, Weltevreden	Zhang et al., 2017
Cashew, raw	Retail, US (prepacked, conventional and organically grown)	375	510	1	0.20	Mbandaka	Zhang et al., 2021
Cashew, roasted	Retail, UK	25	130	0	0		Little et al., 2009
Cashew, treated	Retail, UK	25	459	0	0		Little et al., 2010
Cashew, treated	RTE packages at processor, Australia	25	45	0			Eglezos, 2010
Cashew (packaged,	Retail and manufacturers,	25	117	0	0		NSW Food Authority, 2012

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Type of nut	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	No. positive for *Salmonella*	Percent positive (if *n*>50)	*Salmonella* serotype	References
unpackaged, and nut product)	Australia						
Cashew	Retail, Canada	25	201	0	0		CFIA, 2017
Chestnut, inshell	Retail, Canada	25	30	0			CFIA, 2017
Chestnut, shelled	Retail, Canada	25	5	0			CFIA, 2017
Coconut	Husked nuts from 5 countries	25 ml of lactose broth rinse (from 100 ml/nut)	15	<4/shell			Kajs et al., 1976
Coconut, desiccated	Imports from Sri Lanka (Ceylon), sampled in Australia	not given	35	9		Paratyphi B (1/9 samples), Butantan, Edinberg, Perth	Kovacs, 1959
Coconut, desiccated (shred, flake, flour)	Imports from Sri Lanka (Ceylon), sampled in UK	20-25 g (duplicate samples)	851	76	9.2	Paratyphi B (15/78 isolates) and 17 others	Galbraith et al., 1960
Coconut, desiccated	Port receiving, England	not given	8,265	479	5.8	Paratyphi B (42/479) and others	Summarized by Semple et al., 1961
Coconut, desiccated	Processing mills, Sri Lanka (Ceylon)	20	1,363	31	2.3	Paratyphi B, Typhimurium, Senftenberg, 6 others	Velaudapillai et al., 1963
Hazelnut, raw	Processor receiving, Australia	25	48	0			Eglezos et al., 2008
Hazelnut, raw (shelled)	Retail, US (prepacked conventional and organically grown)	375	577	2	0.35	Escanaba, Typhimurium	Zhang et al., 2017
Hazelnut, raw (shelled)	Retail, US (prepacked conventional and organically grown)	375	487	0			Zhang et al., 2021
Hazelnut, roasted	Retail, UK	25	38	0			Little et al., 2009
Hazelnut, treated	Retail, UK	25	195	0	0		Little et al, 2010
Hazelnut, treated	RTE packages at processor, Australia	25	51	0	0		Eglezos, 2010
Hazelnut (packaged, unpackaged, and nut product)	Retail, manufacturers, and growers, Australia	25	34	0			NSW Food Authority, 2012
Hazelnut, inshell	Retail, US	375	80	0	0		Zhang et al., 2017

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Type of nut	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	No. positive for *Salmonella*	Percent positive (if *n*>50)	*Salmonella* serotype	References
	(prepacked conventional and organically grown)						
Hazelnut, inshell	Processors, US (after first drying stage)	375	472	157	33.3 (for 2013–14)	(not determined)	Letchworth, 2020
Hazelnut, inshell	Retail, Canada	25	696	3	0.43	(not determined)	CFIA, 2017
Hazelnut, shelled	Retail, Canada	25	870	0	0		CFIA, 2017
Macadamia, raw	Processors	not given	93	1	N/A[b]		St. Clair and Klenk, 1990
Macadamia, raw (shelled)	Retail, US (prepacked conventional and organically grown)	375	355	15	4.20	Diarizonae, Florida, Gaminara, Heidelberg, Mbandaka, Orientalis, Plymouth, Shamba, Uzaramo, Worthington, II 42:r:−, IIIb	Zhang et al., 2017
Macadamia, raw (shelled)	Retail, US (prepacked conventional and organically grown)	375	278	7	2.52	Give, Muenchen, Urbana, *diarizonae* O61, *diarizonae* N.N.	Zhang et al., 2021
Macadamia, roasted	Retail, UK	25	14	0			Little et al., 2009
Macadamia, treated	Retail, UK	25	65	0	0		Little et al., 2010
Macadamia (packaged, unpackaged, and nut product)	Retail, manufacturers, and growers, Australia	25	76	1	3	Aberdeen	NSW Food Authority, 2012
Macadamia, shelled	Retail, Canada	25	5	0			CFIA, 2017
Peanut, raw (whole, shelled)	Retail, Scotland	25	4 (2 whole, 2 shelled)	0			Candlish et al., 2001
Peanut, raw	Processor receiving, Australia	25	653	0	0		Eglezos et al., 2008
Peanut, raw shelled (runner type)	Processors, US	350	10,162	68	0.67 (average for 2009–11)	Serotyping not done; PFGE indicated multiple serotypes	Miksch et al., 2013
Peanut, raw shelled	Processors, US	375	944	22	2.3	Agona, Anatum, Dessau, Braenderup, Hartford, Meleagridis, Muenchen,	Calhoun et al., 2013

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Type of nut	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	No. positive for *Salmonella*	Percent positive (if *n*>50)	*Salmonella* serotype	References
						Rodepoort, Tennessee, Tornow, sp. C(1):m,t, sp. G(1):b;−	
Peanut, raw shelled	Processors, US	375	2,506	41	1.63	Agona, Anatum, Bardo, Braenderup, Cannstatt, Dessau, Gaminara, Litchfield, Hartford, Inverness, Mbandaka, Meleagridis, Muenchen, Newport, Pakistan, Rodepoort, Rubislaw, Tennessee, Tornow, sp. C(1):m,t, sp. G(1):b;−	Calhoun et al., 2018, 2019
Peanut, shelled (raw and treated)	Processors, Brazil	250 (10 × 25)	125	0	0		Nascimento et al., 2018
Peanut, shelled (raw and treated)	Retail, Brazil	250 (10 × 25)	25	0	N/A		Nascimento et al., 2018
Peanut, shelled	Retail (bulk), Mexico	25	70	22	31.4	Tennessee	Aguilar Vázquez et al., 2022
Peanut, roasted	Retail, UK	25	26	0			Little et al., 2009
Peanut, treated	RTE packages at processor, Australia	25	343	0	0		Eglezos, 2010
Peanut, treated	RTE packages, retail, UK	25	148	0	0		Little et al., 2010
Peanut (packaged, unpackaged, and nut product)	Retail and manufacturers, Australia	25	196	0	0		NSW Food Authority, 2012
Peanut, inshell	Growers, Brazil	250 (10 × 25)	129	6	4.7	Miami, Muenster	Nascimento et al., 2018
Peanut, inshell	Processor receiving, Brazil	250 (10 × 25)	20	0			Nascimento et al., 2018
Peanut, inshell	Processor drying, Brazil	250 (10 × 25)	40	2	N/A	Javiana, Oranienburg	Nascimento et al., 2018
Peanut, inshell	Retail, Brazil	250 (10 × 25)	3	1	N/A	Glostrup, Miami	Nascimento et al., 2018
Peanut, inshell	Retail, Canada	25	233	0	0		CFIA, 2017
Peanut, shelled	Retail, Canada	25	106	0	0		CFIA, 2017
Pecan, raw (shelled)	Retail, US (prepacked	375	623	0			Zhang et al., 2017

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Type of nut	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	No. positive for *Salmonella*	Percent positive (if *n*>50)	*Salmonella* serotype	References
	conventional and organically grown)						
Pecan, raw (shelled)	Retail, US (prepacked conventional and organically grown)	375	510	0			Zhang et al., 2021
Pecan, inshell	Processors, US	100	4,641	44	0.95% (average for 2010–14)	31 serotypes, including: Braenderup (7%); Enteritidis (12%); Javiana (9%); Livingstone (5%); Newport (5%); Oranienburg (5%)	Brar et al., 2016
Pecan, roasted	Retail, UK	25	25	0			Little et al., 2009
Pecan, treated	Retail, UK	25	151	0			Little et al., 2010
Pecan (packaged, unpackaged)	Retail, manufacturers, and growers, Australia	25	12	0			NSW Food Authority, 2012
Pecan, inshell	Retail, Canada	25	40	0			CFIA, 2017
Pecan, shelled	Retail, Canada	25	86	0	0		CFIA, 2017
Pecan, shelled	Retail (bulk), Mexico	25	70	28	40	Tennessee	Aguilar Vázquez et al., 2022
Pine nut, raw (shelled)	Retail, US (prepacked conventional and organically grown)	375	630	3	0.48	Baildon, Derby, Thompson	Zhang et al., 2017
Pine nut, raw (shelled)	Retail, US (prepacked conventional and organically grown)	375	500	0			Zhang et al., 2021
Pine nut, roasted	Retail, UK	25	29	0			Little et al., 2009
Pine nut, shelled	Retail, Canada	25	43	0			CFIA, 2017
Pistachio, raw whole	Retail, Scotland	25	2	0			Candlish et al., 2001
Pistachio, raw (shelled)	Retail, US (prepacked conventional and organically grown)	375	295	7	2.37	Duisburg, Liverpool, Mbandaka, Montevideo, Senftenberg, Worthington	Zhang et al., 2021

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Type of nut	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	No. positive for *Salmonella*	Percent positive (if *n*>50)	*Salmonella* serotype	References
Pistachio, raw inshell	Processor receiving, California	100	3,968	32	0.81 (average for 2010–12)	Enteritidis, Liverpool, Montevideo, Senftenberg, Tennessee, Worthington	Harris et al., 2016
Pistachio, roasted	Retail, UK	25	25	1		Havana	Little et al., 2009
Pistachio, treated (kernels, inshell)	Retail, UK	25	184 (kernels only, 73; inshell, 111)	0			Little et al., 2010
Pistachio (packaged, unpackaged, and nut product)	Retail, manufacturers, and growers, Australia	25	76	0	0		NSW Food Authority, 2012
Pistachio, inshell	Retail, Canada	25	481	0	0		CFIA, 2017
Pistachio, shelled	Retail, Canada	25	22	0			CFIA, 2017
Walnut, raw kernels	India (Kashmir and Jammu)	10	50	1	2	(not determined)	Riyaz-Ul-Hassan et al., 2003
Walnut, raw (shelled)	Retail, US (prepacked conventional and organically grown)	375	658	8	1.22	Irumu, Montevideo, Muenchen, Oranienburg, Thompson	Zhang et al., 2017
Walnut, raw (shelled)	Retail, US	375	498	0	0		Hammack, 2018 [unpublished 2015–2016 survey data]; Santillana Farakos et al., 2019
Walnut, raw (shelled)	Retail, US (prepacked conventional and organically grown)	375	498	0			Zhang et al., 2021
Walnut, raw inshell	Processor, California	100	935	0	0 (2010)		Davidson et al., 2015
Walnut, raw inshell	Processor, California	375	2,903	4	0.14 (average for 2011–13)	Bovismorbificans, Enteritidis, Muenchen, Saintpaul	Davidson et al., 2015
Walnut, roasted	Retail, UK	25	74	0	0		Little et al., 2009
Walnut, treated	Retail, UK	25	441	0	0		Little et al., 2010
Walnut (packaged, unpackaged, and	Retail, manufacturers, and growers, Australia	25	80	0	0		NSW Food Authority, 2012

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Type of nut	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	No. positive for *Salmonella*	Percent positive (if *n*>50)	*Salmonella* serotype	References
nut product)							
Walnut, inshell	Retail, Canada	25	792	2	0.25	(not determined)	CFIA, 2017
Walnut, shelled	Retail, Canada	25	874	0	0		CFIA, 2017
Mixed nuts, roasted	Retail, UK	25	63	0	0		Little et al., 2009
Mixed nuts, treated (almond, Brazil nut, cashew, peanut, walnut)	Retail, UK	25	105	1	1	Anatum	Little et al., 2010
Mixed nuts (packaged, unpackaged, and nut product)	Retail, manufacturers, and growers, Australia	25	131	0	0		NSW Food Authority, 2012
Mixed nuts, inshell	Retail, Canada	25	35	0			CFIA, 2017
Mixed nuts, shelled	Retail, Canada	25	14	0			CFIA, 2017
Other – 13 unpackaged nuts, seeds and snacks[c]	Retail, Turkey	10	217		*Salmonella* and *E. coli* were found in 2.77% of samples; incidence of *Salmonella* alone was not given	(not determined)	Vural and Erkan, 2008

[a] Sample size is the size of the sample that was enriched and used to determine the prevalence (percent positive samples).

[b] N/A, not applicable. The study was designed to compare the performance of several methods for recovering *Salmonella* from food; samples of macadamia included in the study were from lots that had already tested positive for *Salmonella*.

[c] Nuts incl. almond, hazelnut, peanut, walnut, Antep [Turkish] pistachio, and mixed nuts; seeds incl. Dakota sunflower, melon, pumpkin, and watermelon; samples also incl. roasted chickpea, sauced roasted chickpea, and sauced roasted corn.

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Table 2. Prevalence of *Salmonella* on naturally contaminated edible seeds

Type of seed or product	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	No. positive for *Salmonella*	Percent positive (if *n*>50)	*Salmonella* serotype	References
Alfalfa	Retail, UK	25	58	1	1.7	(not given)	Willis et al., 2009
Amaranth	Retail, Mexico	25	100	15	15	(not given)	Juárez Arana et al., 2021
Chia	Retail, Mexico	25	100	31	31	(not given)	Juárez Arana et al., 2021
Chia	Retail, Portugal	25	18	0			Silva et al., 2022
Flax (linseed)	Retail, UK	25	284	1	0.4	(not given)	Willis et al., 2009
Flax	Retail, Portugal	25	18	0			Silva et al., 2022
Hemp	Retail, UK	25	121	0	0		Willis et al., 2009
Melon	Retail, UK	25	47	4	8.5	Unnamed (47:z4,z23:-)	Willis et al., 2009
Poppy	Retail, UK	25	202	0	0		Willis et al., 2009
Pumpkin	Retail, UK	25	886	0	0		Willis et al., 2009
Pumpkin	Retail, Portugal	25	18	0			Silva et al., 2022
Sesame	Retail, UK	25	771	13	1.7	Drypool Unnamed (47:z4,z23:-)	Willis et al., 2009
Sesame	Retail, Germany	25	16	2		Offa, Tennessee	Brockmann et al., 2004
Sesame	US points of entry (country of origin not specified)	375	177	20	11	Anatum, Bonn, Cerro, Give, Glostrup, Havana, Kentucky, Idikan, Llandoff, Mbandaka, Newport, Potsdam, Senftenberg, Tennessee, Weltevreden, Westminister, 3,10:b:-, *S. enterica* subspecies arizonae serotype 48:z4,z24:-	Van Doren et al., 2013a

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Type of seed or product	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	No. positive for *Salmonella*	Percent positive (if *n*>50)	*Salmonella* serotype	References
Sesame	US points of entry (country of origin not specified)	1500	233	23	9.9	(not given)	Van Doren et al., 2013b
Sesame	Retail, Mexico	25	100	12	12	(not given)	Juárez Arana et al., 2021
Sesame	Retail, Italy	50	36	3		Montevideo, Stanleyville, Tilene	D'Oca et al., 2021
Sesame	Retail, Portugal	25	18	0			Silva et al., 2022
Sunflower	Retail, UK	25	976	1	0.1	(not given)	Willis et al., 2009
Sunflower	Retail, Portugal	25	18	0			Silva et al., 2022
Other – 13 unpackaged nuts, seeds and snacks[b]	Retail, Turkey	10	217		*Salmonella* and *E. coli* were found in 2.77% of samples; incidence of *Salmonella* alone not given	(not determined)	Vural and Erkan, 2008

[a] Sample size is the size of the sample that was enriched and used to determine the prevalence (percent positive samples).

[b] Nuts incl. almond, hazelnut, peanut, walnut, Antep [Turkish] pistachio, and mixed nuts; seeds incl. Dakota sunflower, melon, pumpkin, and watermelon; samples also incl. roasted chickpea, sauced roasted chickpea, and sauced roasted corn.

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Table 3. Levels of *Salmonella* in positive samples of naturally contaminated nuts and edible seeds

Type of nut or seed	Where collected	Sample size (g)	*Salmonella* levels (MPN/g)	References
Nut				
Almond, raw kernel	Processor receiving, California	100 × 1 and 3 each: 25, 2.5, 0.25	96 samples: 0.0044 to 0.15 for 2002–06; 4 samples: 0.00080, 0.00080, 0.00095, 0.0034 for 2010; 10 samples: 0.002 to 0.032 for unpublished [2013 data]	Bansal et al., 2010; Danyluk et al., 2007; Lambertini et al., 2012; Harris, unpublished [2013 data]
Brazil nut, treated	Retail, UK	10 tube: 10	2 samples: 0.23, 0.09	Little et al., 2010
Cashew, raw	Retail, US	3 tube: 100, 10, 1, 0.1, 0.01	1 sample: <0.003	Zhang et al., 2021
Coconut, desiccated (shred, flake, flour)	Imports from Sri Lanka (Ceylon), sampled in UK	Not given	<0.03	Galbraith et al., 1960
Hazelnut, inshell	Processor drying, US	3 tube: 3 each (333, 33, 3)	154 samples: 0.00092 to 0.307 for 2013–14	Letchworth, 2020
Macadamia, raw (shelled)	Retail, US	3 tube: 100, 10, 1, 0.1, 0.01	4 samples: <0.003 3 samples: 0.0036, 0.15, 0.75	Zhang et al., 2021
Mixed nuts (almond, Brazil nut, cashew, peanut, walnut)	Retail, UK	10 tube: 10	<0.010	Little et al., 2010
Peanut, inshell	Growers, Brazil	10 tube: 25	6 samples: 0.004 to 0.092	Nascimento et al., 2018
Peanut, inshell	Processor drying, Brazil	10 tube: 25	2 samples: 0.004	Nascimento et al., 2018
Peanut, inshell	Retail, Brazil	10 tube: 25	1 sample: 0.009	Nascimento et al., 2018
Peanut, raw (shelled)	Processors, US	3 tube: 10, 1, 0.1	22 samples: <0.030 to 2.4	Calhoun et al., 2013
Peanut, raw (shelled)	Processors, US	3 tube: 10, 1, 0.1	41 samples: <0.003 to 2.4	Calhoun et al., 2018, 2019
Peanut, raw (shelled)	Processors, US	350 × 1 and 3 each: 100, 10, 1	56 samples: 0.0020 9 samples: 0.0048 to 0.015	Miksch et al., 2013
Pecan, inshell	Processors, US	100 × 1 and 3 each: 25, 2.5, 0.25	44 samples: <0.0047 to 0.39 for 2010–14	Brar et al., 2016

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Type of nut or seed	Where collected	Sample size (g)	*Salmonella* levels (MPN/g)	References
Pistachio, raw inshell	Processors, US	100 × 1, multiple 50, and 3 each: 5.6, 0.56	11 samples (sinkers): 0.0046 21 samples (floaters): 0.012 to 0.43	Harris et al., 2016
Pistachio, raw (shelled)	Retail, US	3 tube: 100, 10, 1, 0.1, 0.01	4 samples: <0.003 3 samples: 0.0036, 0.0092, 0.092	Zhang et al., 2021
Walnut, raw inshell	Processors, US	375 × 1 and: 2 × 50 or 10 × 50 or 1 × 120	3 samples: 0.0032, 0.0038, 0.0042	Davidson et al., 2015
Seed				
Amaranth	Retail, Mexico	Not given	15 samples: <3.0 to 46	Juárez Arana et al., 2021
Chia	Retail, Mexico	Not given	31 samples: <3.0 to 76	Juárez Arana et al., 2021
Sesame	Retail, Mexico	Not given	12 samples: <3.0 to 43	Juárez Arana et al., 2021
Sesame	US points of entry	375 × 4 and 12 each: 100, 10, 1, 0.1	23 samples: 0.0006 to 0.042	Van Doren et al., 2013b
Mixed seeds (alfalfa, flax, melon, sesame, sunflower)	Retail, UK	10 tube: 10	4 samples: <0.1 2 samples: 0.1, 0.2	Willis et al., 2009

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Table 4. Prevalence of other foodborne pathogens (non-*Salmonella*) or generic *E. coli* on naturally contaminated nuts and edible seeds

Type of nut or seed	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	Assay	References
Almond, raw kernel	Processor receiving, California	MPN (limit of detection 0.3 MPN/g)	2,718	Generic *E. coli* (2580 negative; 95 positive at 0.3 to 46 MPN/g [two samples])	Bansal et al., 2010; Danyluk et al., 2007
Almond, raw inshell	Processor receiving, California	MPN (limit of detection 0.3 MPN/g)	15	Generic *E. coli* (13 negative; 2 positive at 0.3 to 0.7 MPN/g	Bansal et al., 2010
Almond, raw kernel	Processor receiving, Australia	25	60	Generic *E. coli* (none positive)	Eglezos et al., 2008
Almond, treated	RTE packages at processor, Australia	25	42	Generic *E. coli, Listeria monocytogenes* and coagulase-positive staphylococci (none positive)	Eglezos, 2010
Almond, inshell	Retail, Canada	25	86	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Almond, shelled	Retail, Canada	25	319	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Brazil nut	Processor receiving, Australia	25	60	Generic *E. coli* (none positive)	Eglezos et al., 2008
Brazil nut	RTE packages at processor, Australia	25	40	Generic *E. coli, Listeria monocytogenes,* coagulase-positive staphylococci (none positive)	Eglezos, 2010
Brazil nut, raw (shelled)	Retail, Brazil	not given	two 2-kg samples, subsample size not given	Generic *E. coli, Bacillus cereus*, *and Staphylococcus aureus* isolated from at least one sample	Freire and Offord, 2002
Brazil nut, inshell	Retail, Canada	25	7	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Brazil nut, shelled	Retail, Canada	25	67	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Cashew, raw	Processor receiving, Australia	25	100	Generic *E. coli* (none positive)	Eglezos et al., 2008
Cashew, treated	RTE packages at processor, Australia	25	45	Generic *E. coli, Listeria monocytogenes* and coagulase-positive staphylococci (none positive)	Eglezos, 2010
Cashew	Retail, Canada	25	201	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Chestnut, inshell	Retail, Canada	25	30	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Chestnut, shelled	Retail, Canada	25	5	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Coconut	Husked nuts from 5 countries	25 ml of lactose broth rinse (from 100 ml/nut)	15	Coagulase-positive staphylococci (none positive)	Kajs et al., 1976
Hazelnut, raw	Processor receiving, Australia	25	48	Generic *E. coli* (none positive)	Eglezos et al., 2008
Hazelnut, treated	RTE packages at processor, Australia	25	51	Generic *E. coli, Listeria monocytogenes* and coagulase-positive staphylococci (none positive)	Eglezos, 2010

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Type of nut or seed	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	Assay	References
Hazelnut, inshell	Retail, Canada	25	696	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Hazelnut, shelled	Retail, Canada	25	870	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Macadamia, shelled	Retail, Canada	25	5	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Peanut, inshell	Growers, Brazil	250 (10 × 25)	129	Generic *E. coli* (6 positive)	Nascimento et al., 2018
Peanut, inshell	Processor receiving, Brazil	250 (10 × 25)	20	Generic *E. coli* (none positive)	Nascimento et al., 2018
Peanut, inshell	Processor drying, Brazil	250 (10 × 25)	40	Generic *E. coli* (none positive)	Nascimento et al., 2018
Peanut, inshell	Retail, Brazil	250 (10 × 25)	3	Generic *E. coli* (none positive)	Nascimento et al., 2018
Peanut, inshell	Retail, Canada	25	233	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Peanut, shelled	Retail, Canada	25	106	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Peanut, raw shelled (runner)	Processors, US	350	10,162	Enterohemorrhagic *E. coli* (3/10,162 positive)	Miksch et al., 2013
Peanut, shelled (raw and treated)	Processors, Brazil	250 (10 × 25)	125	Generic *E. coli* (none positive)	Nascimento et al., 2018
Peanut, shelled (raw and treated)	Retail, Brazil	250 (10 × 25)	25	Generic *E. coli* (none positive)	Nascimento et al., 2018
Peanut (raw whole 2; shelled 2)	Retail, Scotland	25	4	*Listeria* spp. and *Staphylococcus aureus* (none positive)	Candlish et al., 2001
Peanut, raw	Processor receiving, Australia	25	653	Generic *E. coli* (negative)	Eglezos et al., 2008
Peanut, treated	RTE packages at processor, Australia	25	343	Generic *E. coli, Listeria monocytogenes* and coagulase-positive staphylococci (none positive)	Eglezos, 2010
Peanut, shelled	Retail (bulk), Mexico	10	70	Generic *E. coli* (14/70 positive; <0.5–1.4 log MPN/g), *Staphylococcus aureus* (none positive)	Aguilar Vázquez et al., 2022
Pecan, shelled	Retail (bulk), Mexico	10	70	Generic *E. coli* (9/70 positive; <0.5–1 log MPN/g), *Staphylococcus aureus* (none positive)	Aguilar Vázquez et al., 2022
Pecan, inshell	Retail, Canada	25	40	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Pecan, shelled	Retail, Canada	25	86	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Pine nut, shelled	Retail, Canada	25	43	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Pistachio, raw whole	Retail, Scotland	25	2	*Staphylococcus aureus* (350 CFU/g)	Candlish et al., 2001
Pistachio, inshell	Retail, Canada	25	481	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Pistachio, shelled	Retail, Canada	25	22	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Walnut, raw	Processor,	375	2,903	*E. coli* O157:H7 (none positive)	Davidson et al., 2015

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Type of nut or seed	Where collected	Sample size (g)[a]	No. of samples tested (*n*)	Assay	References
inshell	California				
Walnut, raw inshell	Processor, California	MPN (limit of detection 0.3 MPN/g)	386	Generic *E. coli* (10 positive; 0.4 to 110 MPN/g)	Davidson et al., 2015
Walnut, inshell	Retail, Canada	25	792	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Walnut, shelled	Retail, Canada	25	874	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Walnut, raw	India (Kashmir and Jammu)	10	50	*Staphylococcus* spp. (5 positive) and *Bacillus cereus* (3 positive)	Riyaz-Ul-Hassan et al., 2003
Mixed nuts, inshell	Retail, Canada	25	35	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Mixed nuts, shelled	Retail, Canada	25	14	*E. coli* O157:H7, generic *E. coli* (none positive)	CFIA, 2017
Seeds – chia, flax, pumpkin, sesame, sunflower, or mixed seeds	Retail, Portugal	25	126 (18 for each seed type or mixed)	Generic *E. coli*, *Staphylococcus* (none positive)	Silva et al., 2022
Other – 13 unpackaged nuts, seeds and snacks[b]	Retail, Turkey	10	217	*E. coli* and *Salmonella* were found in 2.77% of samples; incidence of each microorganism alone not given *Staphylococcus, Micrococcus, Clostridium perfringens, Bacillus cereus* (negative)	Vural and Erkan, 2008

[a] Sample size is the size of the sample that was enriched and used to determine the prevalence (percent positive samples).

[b] Nuts incl. almond, hazelnut, peanut, walnut, Antep (Turkish) pistachio, and mixed nuts; seeds incl. Dakota sunflower, melon, pumpkin, and watermelon; samples also incl. roasted chickpea, sauced roasted chickpea, and sauced roasted corn.

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References Cited

Aguilar Vázquez, J. C., A. Godínez Oviedo, J. E. Lucero Mejía, D. D'Souza, A. Palacios Marmolejo, and M. Iturriaga. 2022. Microbiological profile, prevalence and characterization of *Salmonella enterica* in peanuts, pecans, raisins, sun-dried tomatoes, and chocolate sprinkles sold in bulk in markets of Queretaro, Mexico. *J. Food Prot.* (online 10 June 2022).

Arrus, K., G. Blank, R. Clear, R. A. Holley, and D. Abramson. 2005. Microbiological and aflatoxin evaluation of Brazil nut pods and the effects of unit processing operations. *J. Food Prot.* 68:1060–1065.

Bansal, A., T. M. Jones, S. J. Abd, M. D. Danyluk, and L. J. Harris. 2010. Most-probable-number determination of *Salmonella* levels in naturally contaminated raw almonds using two sample preparation methods. *J. Food Prot*. 73:1986–1992.

Brar, P. K., L. K. Strawn, and M. D. Danyluk. 2016. Prevalence, level, and types of *Salmonella* isolated from North American in-shell pecans over four harvest years. *J. Food Prot.* 79:352–360. Available at: https://dx.doi.org/10.4315/0362-028X.JFP-15-365.

Brockmann, S. O., I. Piechotowski, and P. Kimmig. 2004. *Salmonella* in sesame seed products. *J. Food Prot.* 67:178–180.

Calhoun, S., L. Post, B. Warren, S. Thompson, and A. R. Bontempo. 2013. Prevalence and concentration of *Salmonella* on raw shelled peanuts in the United States. *J. Food Prot.* 76:575–579.

Calhoun, S., L. Post, B. Warren, S. Thompson, and A. R. Bontempo. 2018. Prevalence and concentration of *Salmonella* on raw, shelled peanuts in the United States. *J. Food Prot*. 81:1755–1760.

Calhoun, S. and coauthors. 2019. Erratum. [Table 2]. *J. Food Prot*. 82:6. doi:10.4315/0362-028X.82.01.6

Canadian Food Inspection Agency (CFIA). 2017. Bacterial pathogens on in-shell nuts and in shelled nuts and nut butters (2012–2015). Available at: https://www.inspection.gc.ca/food-safety-for-industry/food-chemistry-and-microbiology/food-safety-testing-bulletin-and-reports/bacterial-pathogens-on-in-shell-nuts-and-in-shelle/eng/1513147581367/1513147581913.

Candlish, A. A. G., S. M. Pearson, K. E. Aidoo, J. E. Smith, B. Kelly, and H. Irvine. 2001. A survey of ethnic foods for microbial quality and aflatoxin content. *Food Addit. Contam*. 18:129–136.

Danyluk, M. D., T. M. Jones, S. J. Abd, F. Schlitt-Dittrich, M. Jacobs, and L. J. Harris. 2007. Prevalence and amounts of *Salmonella* found on raw California almonds. *J. Food Prot.* 70:820–827.

Davidson, G. R., J. C. Frelka, M. Yang, T. M. Jones, and L. J. Harris. 2015. Prevalence of *Escherichia coli* O157:H7 and *Salmonella* on inshell California walnuts. *J. Food Prot*. 78:1547–1553.

D'Oca, M. C., A. M. Di Noto, A. Bartolotta, A. Parlato, L. Nicastro, S. Sciortino, and C. Cardamone. 2021. Assessment of contamination of *Salmonella* spp. in imported black pepper and sesame seed and *Salmonella* inactivation by gamma irradiation. *Italian J. Food Safety* 10:8914. Available at: https://doi.org/10.4081/ijfs.2021.8914.

Eglezos, S. 2010. The bacteriological quality of retail-level peanut, almond, cashew, hazelnut, Brazil, and mixed nut kernels produced in two Australian nut-processing facilities over a period of 3 years. *Foodborne Pathog. Dis*. 7:863–866.

Eglezos, S., B. Huang, and E. Stuttard. 2008. A survey of the bacteriological quality of preroasted peanut, almond, cashew, hazelnut and Brazil nut kernels received into three Australian nut-processing facilities over a period of 3 years. *J. Food Prot.* 71:402–404.

Freire, F. C. O., and L. Offord. 2002. Bacterial and yeast counts in Brazilian commodities and spices. *Brazilian J. Microbiol.* 33:145–148.

Galbraith, N. S., B. C. Hobbs, M. E. Smith, A. J. H. Tomlinson. 1960. Salmonellae in desiccated coconut. An interim report. *Mon. Bull. Min. Health Lab. Serv.* 19:99–106.

Hammack, T. S. 2018. Preliminary results from the 2015–2016 survey of *Salmonella* in walnuts in the United States. U.S. Food and Drug Administration, Silver Spring, MD.

L. J. Harris, S. Yada, L. R. Beuchat, and M. D. Danyluk. Initial funding (2009–2013) provided by USDA NIFSI, 2009-01951. Currently (2021-present) supported by the Agriculture and Food Research Initiative, Sustainable Agricultural Systems Program grant no. 2020-68012-31822 from the USDA National Institute of Food and Agriculture. Updated 9/30/2022.

Harris, L. J., V. Lieberman, R. P. Mashiana, E. Atwill, M. Yang, J. C. Chandler, B. Bisha, and T. Jones. 2016. Prevalence and amounts of *Salmonella* found on raw California inshell pistachios. *J. Food Prot*. 79:1304–1315.

Juárez Arana, C., R. A. Martínez Peniche, M. G. Martínez, and M. H. Iturriaga. 2021. Microbiological profile, incidence and behavior of *Salmonella* on seeds traded in Mexican markets. *J. Food Prot.* 84:99–105.

Kajs, T. M., R. Hagenmaier, C. Vanderzant, and K. F. Mattil. 1976. Microbiological evaluation of coconut and coconut products. *J. Food Sci.* 41:352–356.

Kovacs, N. 1959. Salmonellae in desiccated coconut, egg pulp, fertilizer, meat-meal and mesenteric glands: preliminary report. *Med. J. Aust.* 46(17):557–559.

Lambertini, E., M. D. Danyluk, D. W. Schaffner, C. K. Winter, and L. J. Harris. 2012. Risk of salmonellosis from consumption of almonds in the North American market. *Food Res. Int.* 45:1166–1174.

Letchworth, C. A. 2020. Reduction of *Salmonella* spp. on in-shell hazelnuts using continuous steam blanching and prevalence of *Salmonella* spp. on in-shell Oregon hazelnuts. M.S. thesis. Oregon State University, Corvallis. Available at: https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/0c483r91s.

Little, C. L., W. Jemmott, S. Surman-Lee, L. Hucklesby, and E. de Pinna. 2009. Assessment of microbiological safety of edible roasted nut kernels on retail sale in England, with a focus on *Salmonella. J. Food Prot.* 72:853–855.

Little, C. L., N. Rawal, E. de Pinna, and J. McLauchlin. 2010. Survey of *Salmonella* contamination of edible nut kernels on retail sale in the UK. *Food Microbiol*. 27:171–174.

Miksch, R., J. Leek, S. Myoda, T. Nguyen, K. Tenney, V. Svidenko, K. Greeson, and M. Samadpour. 2013. Prevalence and counts of *Salmonella* and enterohemorrhagic *Escherichia coli* in raw, shelled runner peanuts. *J. Food Prot.* 76:1668–1675.

Nascimento, M. S., J. A. Carminati, I. C. R. N. Silva, D. L. Silva, A. O. Bernardi, and M. V. Copetti. 2018. *Salmonella*, *Escherichia coli* and Enterobacteriaceae in the peanut supply chain: from farm to table. *Food Res. Int.* 105:930–935.

NSW Food Authority. 2012. Report on the prevalence of *Salmonella* and *E. coli* in ready to eat nuts and nut products sold in Australia. Available at: https://www.foodauthority.nsw.gov.au/about-us/science/market-analysis/nuts-and-nut-products.

Riyaz-Ul-Hassan, S., V. Verma, A. Malik, and G. N. Qazi. 2003. Microbiological quality of walnut kernels and apple juice concentrate. *World J. Microbiol. Biotechnol.* 19:845–850.

Santillana Farakos, S. M., R. Pouillot, G. R. Davidson, R. Johnson, I. Son, N. Anderson, and J. M. Van Doren. 2019. A quantitative risk assessment of human salmonellosis from consumption of walnuts in the United States. *J. Food Prot.* 82:45–57. Available at: https://jfoodprotection.org/doi/pdf/10.4315/0362-028X.JFP-18-233.

Santillana Farakos, S. M., R. Pouillot, R. Johnson, J. Spungen, I. Son, N. Anderson, and J. M. Van Doren. 2017. A quantitative assessment of the risk of human salmonellosis arising from the consumption of almonds in the United States: the impact of preventive treatment levels. *J. Food Prot*. 80:863–878. Available at: https://doi.org/10.4315/0362-028X.JFP-16-403.

Semple, A. B., W. H. Parry, and A. J. Graham. 1961. Paratyphoid fever traced to desiccated coconut. *Lancet* 278(7198):364–365.

Silva, D., P. Nunes, J. Melo, and C. Quintas. 2022. Microbial quality of edible seeds commercially available in southern Portugal. *AIMS Microbiol.* 8(1):42–52. Available at: http://www.aimspress.com/article/doi/10.3934/microbiol.2022004.

St. Clair, V. J., and M. M. Klenk. 1990. Performance of three methods for the rapid identification of *Salmonella* in contaminated foods and feeds. *J. Food Prot.* 53:961–964.

L. J. Harris, S. Yada, L. R. Beuchat, and M. D. Danyluk. Initial funding (2009–2013) provided by USDA NIFSI, 2009-01951. Currently (2021-present) supported by the Agriculture and Food Research Initiative, Sustainable Agricultural Systems Program grant no. 2020-68012-31822 from the USDA National Institute of Food and Agriculture. Updated 9/30/2022.

Van Doren, J. M., D. Kleinmeier, T. S. Hammack, and A. Westerman. 2013a. Prevalence, serotype diversity, and antimicrobial resistance of *Salmonella* in imported shipments of spice offered for entry to the United States, FY2007–FY2009. *Food Microbiol*. 34:239–251.

Van Doren, J. M., R. J. Blodgett, R. Pouillot, A. Westerman, D. Kleinmeier, G. C. Ziobro, Y. Ma, T. S. Hammack, V. Gill, M. F. Muckenfuss, and L. Fabbri. 2013b. Prevalence, level and distribution of *Salmonella* in shipments of imported capsicum and sesame seed spice offered for entry to the United States: Observations and modeling results. *Food Microbiol.* 36:149–160.

Velaudapillai, T., K. Nitiananda, and K. Meedeniya. 1963. *Salmonella* in desiccated coconut. *Zeitschrift für Hygiene* 149:122–125.

Vural, A., and M. E. Erkan. 2008. The research of microbiological quality in some edible nut kinds. *J. Food Technol*. 6(1):25–28.

Willis, C., C. L. Little, S. Sagoo, E. de Pinna, and J. Threlfall. 2009. Assessment of the microbiological safety of edible dried seeds from retail premises in the United Kingdom with a focus on *Salmonella* spp. *Food Microbiol*. 26:847–852.

Zhang, G., L. Hu, Y. Luo, S. M. Santillana Farakos, R. Johnson, V. N. Scott, P. Curry, D. Melka, E. W. Brown, E. Strain, V. K. Bunning, S. M. Musser, and T. S. Hammack. 2021. Survey of *Salmonella* in raw tree nuts at retail in the United States. *J. Food Sci.* 86(2):495–504. Available at: https://onlinelibrary.wiley.com/doi/epdf/10.1111/1750-3841.15569.

Zhang, G., L. Hu, D. Melka, H. Wang, A. Laasri, E. W. Brown, E. Strain, M. Allard, V. K. Bunning, S. M. Musser, R. Johnson, S. M. Santillana Farakos, V. N. Scott, R. Pouillot, J. M. Van Doren, and T. S. Hammack. 2017. Prevalence of *Salmonella* in cashews, hazelnuts, macadamia nuts, pecans, pine nuts, and walnuts in the United States. *J. Food Prot.* 80:459–466. Available at: https://www.jfoodprotection.org/doi/pdf/10.4315/0362-028X.JFP-16-396.

L. J. Harris, S. Yada, L. R. Beuchat, and M. D. Danyluk. Initial funding (2009–2013) provided by USDA NIFSI, 2009-01951. Currently (2021-present) supported by the Agriculture and Food Research Initiative, Sustainable Agricultural Systems Program grant no. 2020-68012-31822 from the USDA National Institute of Food and Agriculture. Updated 9/30/2022.