PREVALENCE AND LEVELS OF PATHOGENS, COLIFORMS, AND GENERIC E. COLI FOUND IN GRAINS, FLOUR, AND RELATED PRODUCTS

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Bacteria	Grain	Food Product	Number of Samples Tested	Detection Level (CFU or MPN/g)	Prevalence (percentage of positive samples)	Microbiological levels	Geographic Region	Year Published	Reference
Aerobic plate count	Wheat	Durum wheat crop	178	NR	100%	0.9 to 8.4 log CFU/g	Montana and North Dakota, U.S.	2004	(Manthey *et al.* 2004)
Bacillus cereus	Barley	Cereal	20	1 MPN/g	85%	Most exceeded 10^2 MPN/g	Poland	2019	(Daczkowska-Kozon *et al.* 2009)
Bacillus cereus	Barley	Cereal grain	10	NR	70%	NR	Cairo, Egypt	2006	(Aziz *et al.* 2006)
Bacillus cereus	Buckwheat	Cereal	14	1 MPN/g	86%	Most exceeded 10^2 MPN/g	Poland	2019	(Daczkowska-Kozon *et al.* 2009)
Bacillus cereus	Buckwheat	Flour	8	NR	12.5%	NR	Italy	2017	(Losio *et al.* 2017)
Bacillus cereus	Maize	Cereal grain	10	NR	60%	NR	Cairo, Egypt	2006	(Aziz *et al.* 2006)
Bacillus cereus	Maize	Flour	23	NR	4.3%	NR	Italy	2017	(Losio *et al.* 2017)
Bacillus cereus	Not specified	Breakfast cereals	43	1 log MPN/g	18.6%	≤2.2 log CFU/g	Poland	2019	(Berthold-Pluta *et al.* 2019)
Bacillus cereus	Not specified	Pasta	54	1 log MPN/g	37.0%	≤3.1 log CFU/g	Poland	2019	(Berthold-Pluta *et al.* 2019)
Bacillus cereus	Not specified	Rice	48	1 log MPN/g	27.1%	≤2.1 log CFU/g	Poland	2019	(Berthold-Pluta *et al.* 2019)
Bacillus cereus	Rice (brown)	NR	83	NR	18%	NR	Korea	2009	(Park *et al.* 2009)
Bacillus cereus	Sorghum	Cereal grain	10	NR	70%	NR	Cairo, Egypt	2006	(Aziz *et al.* 2006)
Bacillus cereus	Wheat	After conditioning	90	0.3 MPN/g	64%	10^{-1} to 10^1 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
Bacillus cereus	Wheat	Bran	54	0.3 MPN/g	94%	10^{-1} to 10^2 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
Bacillus cereus	Wheat	Cereal grain	10	NR	80%	NR	Cairo, Egypt	2006	(Aziz *et al.* 2006)
Bacillus cereus	Wheat	Fine reduction	43	0.3 MPN/g	70%	10^{-1} to 10^1 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
Bacillus cereus	Wheat	First break	54	0.3 MPN/g	78%	10^{-1} to 10^2 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
Bacillus cereus	Wheat	Flour	71	0.3 MPN/g	93%	10^{-1} to 10^1 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
Bacillus cereus	Wheat	Flour	350	2.0 log CFU/g	<0.3% (none)	NA	Queensland, Australia	2010	(Eglezos 2010)
Bacillus cereus	Wheat	Flour	142	>10^2 CFU/g	4.2%	6 samples had >10^2 CFU/g	Thrace, Turkey	2009	(Aydin *et al.* 2009)
Bacillus cereus	Wheat	Grain	58	0.3 MPN/g	81%	10^{-1} to 10^1 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
Bacillus cereus	Wheat	Grain	50	2.0 log CFU/g	4%	Up to 2.2 log CFU/g	Queensland, Australia	2010	(Eglezos 2010)
Bacillus cereus	Wheat	Hulled, grits, semolina	14	1 MPN/g	100%	Most exceeded 10^2 MPN/g	Poland	2019	(Daczkowska-Kozon *et al.* 2009)
Bacillus cereus	Wheat	Wheat germ	43	0.3 MPN/g	64%	10^{-1} to 10^1 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
Bacillus cereus	Wheat (hard grade)	Flour	24	50 MPN/g	100%	~0.3 to 50 MPN/g	Australia	1989	(Eyles *et al.* 1989)
Bacillus cereus and Bacillus thuringiensis spores	Rice	Raw rice from retail stores	178	NR	52.8%	Range: 3.6 to 460 CFU/g Mean: 32.6 CFU/g	U.S.	2008	(Ankolekar *et al.* 2009)
Bacillus cereus spores	Wheat (hard grade)	Flour	13	50 MPN/g	92%	0.3 to 9 MPN/g	Australia	1989	(Eyles *et al.* 1989)
Bacillus spp.	Barley	NR	76	NR	21%	NR	Korea	2009	(Park *et al.* 2009)
Bacillus spp.	Job's tears	NR	71	NR	27%	NR	Korea	2009	(Park *et al.* 2009)
Bacillus spp.	Rice (glutinous)	NR	63	NR	37%	NR	Korea	2009	(Park *et al.* 2009)
Clostridia spp.	Wheat	Flour	15	1 log CFU/g	NR	<1 log CFU/g	Spain	1999	(Cordoba *et al.* 1999)
Clostridium botulinum	Wheat	Pasta (no egg)	48	1 spore/200 g	0%	NA	Global	2010	(Peck *et al.* 2010)

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Clostridium botulinum	Wheat	Semolina	13	8 spores/200 g	0%	NA	Global	2010	(Peck *et al.* 2010)
Clostridium perfringens	Barley	Cereal grain	10	NR	100%	3.08 ± 1.3 log CFU/g	Cairo, Egypt	2006	(Aziz *et al.* 2006)
Clostridium perfringens	Corn	Flour	24	NR	0%	NA	U.S.	1974	(Bothast *et al.* 1974)
Clostridium perfringens	Corn	Grits	24	NR	0%	NA	U.S.	1974	(Bothast *et al.* 1974)
Clostridium perfringens	Corn	Whole kernels	24	NR	~17%	NR	U.S.	1974	(Bothast *et al.* 1974)
Clostridium perfringens	Maize	Cereal grain	10	NR	100%	3.04 ± 2.2 log CFU/g	Cairo, Egypt	2006	(Aziz *et al.* 2006)
Clostridium perfringens	Sorghum	Cereal grain	10	NR	100%	3.18 ± 1.2 log CFU/g	Cairo, Egypt	2006	(Aziz *et al.* 2006)
Clostridium perfringens	Wheat	Cereal grain	10	NR	100%	4.08 ± 2.1 log CFU/g	Cairo, Egypt	2006	(Aziz *et al.* 2006)
Clostridium perfringens	Wheat	Flour	142	>10^2 CFU/g	9.7%	14 samples were >10^2 CFU/g; all were below 10^4	Thrace, Turkey	2009	(Aydin *et al.* 2009)
Clostridium spp.	Corn	Corn gluten meal for animal feed	8	NR	NR	2.62 log CFU/g (mean level	U.S.	2021	(Munoz *et al.* 2021)
Clostridium spp.	Corn	Corn meal for animal feed	40	NR	NR	1.94 log CFU/g (mean level)	U.S.	2021	(Munoz *et al.* 2021)
Clostridium spp.	Wheat	Animal feed ingredient	4	NR	NR	1.00 log CFU/g (mean level	U.S.	2021	(Munoz *et al.* 2021)
Coliforms	Barley	Barley flour products	5	3 MPN/g	80%	<3 to 600 MPN/g	Canada	2017	(Boyd *et al.* 2017)
Coliforms	Barley	Other barley products	8	3 MPN/g	62.5%	<3 to 88,000 MPN/g	Canada	2017	(Boyd *et al.* 2017)
Coliforms	Barley	Unprocessed whole grain	4	3 MPN/g	75%	<3 to 185.3 MPN/g	Canada	2017	(Boyd *et al.* 2017)
Coliforms	Corn	Dry-milled corn products	18	NR	NR	0.70 ± 0.76 log MPN/g	North America	2007	(Sperber *et al.* 2007)
Coliforms	Corn	Dry-milled corn products	3456	NR	NR	1.12 ± 0.68 log CFU/g	North America	2007	(Sperber *et al.* 2007)
Coliforms	Corn	Flour	24	NR	NR	6 to 93 CFU/g	U.S.	1974	(Bothast *et al.* 1974)
Coliforms	Corn	Grits	24	NR	NR	0 to 10 CFU/g	U.S.	1974	(Bothast *et al.* 1974)
Coliforms	Corn	Whole kernels	24	NR	NR	2 to 44 CFU/g	U.S.	1974	(Bothast *et al.* 1974)
Coliforms	Oats	Milled oat products	816	NR	NR	0.54 ± 0.69 log MPN/g	North America	2007	(Sperber *et al.* 2007)
Coliforms	Oats	Milled oat products	1599	NR	NR	0.78 ± 0.32 log CFU/g	North America	2007	(Sperber *et al.* 2007)
Coliforms	Rye	Flour, refined	2	NR	50%	<LOQ to 1.70 log CFU/g	Portugal	2019	(Cardoso *et al.* 2019)
Coliforms	Rye	Flour, whole rye	2	NR	100%	2.03 to 2.70 log CFU/g	Portugal	2019	(Cardoso *et al.* 2019)
Coliforms	Wheat	Bran	54	3 MPN/g	89%	10^0 to 10^1 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
Coliforms	Wheat	Flour	71	3 MPN/g	82%	10^0 to 10^3 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
Coliforms	Wheat (durum)	Flour	1084	NR	NR	1.20 ± 0.57 log MPN/g	U.S.	1993	(Richter *et al.* 1993)
Coliforms	Wheat	Flour	1477	NR	NR	1.20 ± 0.59 log MPN/g	North America	2007	(Sperber *et al.* 2007), citing data from earlier uncited work
Coliforms	Wheat	Flour	3688	NR	NR	1.63 ± 0.89 log MPN/g	North America	*2007*	(Sperber *et al.* 2007)
Coliforms	Wheat	Flour	2467	NR	NR	2.65 ± 0.78 log CFU/g	North America	2007	(Sperber *et al.* 2007)

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Coliforms	Wheat	Flour	150	NR	NR	3.02 to 4.01 log CFU/g	Pakistan	2012	(Afiifa Batool *et al.* 2012)
Coliforms	Wheat	Flour, refined	2	NR	100%	2.0 to 3.04 log CFU/g	Portugal	2019	(Cardoso *et al.* 2019)
Coliforms	Wheat	Flour, whole wheat	1	NR	100%	2.00 log CFU/g	Portugal	2019	(Cardoso *et al.* 2019)
Coliforms	Wheat	Flour, whole wheat	295	NR	NR	1.98 ± 0.95 log MPN/g	North America	2007	(Sperber *et al.* 2007)
Coliforms	Wheat	Flour, whole wheat	110	NR	NR	3.64 ± 0.62 log CFU/g	North America	2007	(Sperber *et al.* 2007)
Coliforms	Wheat	Grain	58	3 MPN/g	93%	10^0 to 10^3 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
Coliforms	Wheat	Pasta (no egg)	1212	1 MPN/g	0.75%	All were ≤10 MPN/g	Canada	1981	(Rayman *et al.* 1981)
Coliforms	Wheat	Pasta (no egg)	288	1 MPN/g	4.71%	At least one sample was >100 MPN/g	Imported into Canada	1981	(Rayman *et al.* 1981)
Coliforms	Wheat	Wheat germ	43	3 MPN/g	98%	10^0 to 10^3 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
Coliforms	Wheat (durum)	Flour	282	NR	NR	1.72 ± 1.24 log MPN/g	North America	2007	(Sperber *et al.* 2007)
Coliforms	Wheat (durum)	Flour	152	NR	NR	3.55 ± 0.82 log CFU/g	North America	2007	(Sperber *et al.* 2007)
Coliforms	Wheat (hard red winter)	Flour	120	NR	NR	1.19 ± 0.61 log MPN/g	U.S.	1993	(Richter *et al.* 1993)
Coliforms	Wheat (soft red winter)	Flour	190	NR	NR	1.22 ± 0.66 log MPN/g	U.S.	1993	(Richter *et al.* 1993)
Coliforms	Wheat (spring)	Flour	83	NR	NR	1.14 ± 0.69 log MPN/g	U.S.	1993	(Richter *et al.* 1993)
Cronobacter spp.	Buckwheat	Various products	34	0.3 MPN/100 g	76.5%	NR	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Buckwheat	Various products	20	0.3 MPN/100 g	40%	≤110 MPN/100 g	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Corn	Various products	33	0.3 MPN/100 g	30.3%	NR	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Corn	Various products	6	0.3 MPN/100 g	100%	>110 MPN/100 g	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Job's tears	Various products	40	0.3 MPN/100 g	45.0%	NR	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Job's tears	Various products	9	0.3 MPN/100 g	66.7%	≤1.6 MPN/100g	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Millet	Various products	48	0.3 MPN/100 g	62.5%	NR	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Millet	Various products	16	0.3 MPN/100 g	25%	≤24 MPN/100 g	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Oats	Various products	41	0.3 MPN/100 g	31.7%	NR	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Oats	Various products	6	0.3 MPN/100 g	100%	≤0.36 MPN/100 g	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Rice and related products	Various products	153	0.3 MPN/100 g	42.5%	NR	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Rice and related products	Various products	36	0.3 MPN/100 g	44.4%	≤9.3 MPN/100 g	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Sorghum	Various products	18	0.3 MPN/100 g	16.7%	NR	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Sorghum	Various products	8	0.3 MPN/100 g	50%	≤0.72 MPN/100 g	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Wheat and related products	Various products	100	0.3 MPN/100 g	87.0%	NR	China	2019	(Lou *et al.* 2019)
Cronobacter spp.	Wheat and related products	Various products	26	0.3 MPN/100 g	30.8%	≤9.3 MPN/100 g	China	2019	(Lou *et al.* 2019)

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E. coli (generic)	Barley	Barley flour products	5	3 MPN/g	20%	9.7 MPN/g	Canada	2017	(Boyd *et al.* 2017)
E. coli (generic)	Barley	Other barley products	8	3 MPN/g	0%	NA	Canada	2017	(Boyd *et al.* 2017)
E. coli (generic)	Barley	Unprocessed whole grain	4	3 MPN/g	0%	NA	Canada	2017	(Boyd *et al.* 2017)
E. coli (generic)	Corn	Corn gluten meal for animal feed	8	NR	NR	2.04 log CFU/g (mean level)	U.S.	2021	(Munoz *et al.* 2021)
E. coli (generic)	Corn	Corn meal for animal feed	40	NR	NR	2.85 log CFU/g (mean level)	U.S.	2021	(Munoz *et al.* 2021)
E. coli (generic)	Corn	Dry-milled corn products	18	NR	NR	0	North America	2007	(Sperber *et al.* 2007)
E. coli (generic)	Corn	Dry-milled corn products	3722	NR	NR	0.10 ± 0.25 log CFU/g	North America	2007	(Sperber *et al.* 2007)
E. coli (generic)	Oats	Milled oat products	1142	NR	NR	0.003 ± 0.043 log MPN/g	North America	2007	(Sperber *et al.* 2007)
E. coli (generic)	Oats	Milled oat products	1722	NR	NR	0.70 ± 0.02 log CFU/g	North America	2007	(Sperber *et al.* 2007)
E. coli (generic)	Rye	Flour, refined	2	NR	0%	<LOQ	Portugal	2019	(Cardoso *et al.* 2019)
E. coli (generic)	Rye	Flour, whole rye	2	NR	0%	<LOQ	Portugal	2019	(Cardoso *et al.* 2019)
E. coli (generic)	Wheat	Animal feed ingredient	4	NR	NR	1.83 log CFU/g (mean level)	U.S.	2021	(Munoz *et al.* 2021)
E. coli (generic)	Wheat	Bran	54	3 MPN/g	4%	10^0 to 10^1 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
E. coli (generic)	Wheat	Flour	3735	NR	NR	0.23 ± 0.29 log MPN/g	North America	2007	(Sperber *et al.* 2007)
E. coli (generic)	Wheat	Flour	2921	NR	NR	0.74 ± 0.38 log CFU/g	North America	2007	(Sperber *et al.* 2007)
E. coli (generic)	Wheat	Flour	71	3 MPN/g	1%	10^0 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
E. coli (generic)	Wheat	Flour	15	1 log CFU/g	NR	<1 log CFU/g	Spain	1999	(Cordoba *et al.* 1999)
E. coli (generic)	Wheat	Flour, refined	2	NR	0%	<LOQ	Portugal	2019	(Cardoso *et al.* 2019)
E. coli (generic)	Wheat	Flour, whole wheat	410	NR	NR	0.16 ± 0.27 log MPN/g	North America	2007	(Sperber *et al.* 2007)
E. coli (generic)	Wheat	Flour, whole wheat	135	NR	NR	0.84 ± 0.42 log CFU/g	North America	2007	(Sperber *et al.* 2007)
E. coli (generic)	Wheat	Flour, whole wheat	1	NR	0%	<LOQ	Portugal	2019	(Cardoso *et al.* 2019)
E. coli (generic)	Wheat	Grain	58	3 MPN/g	0%	$<10^0$ MPN/g	Australia	2003	(Berghofer *et al.* 2003)
E. coli (generic)	Wheat	Pasta (no egg)	1212	0.18 MPN/g	0%	NA	Canada	1981	(Rayman *et al.* 1981)
E. coli (generic)	Wheat	Pasta (no egg)	288	0.18 MPN/g	0%		Imported into Canada	1981	(Rayman *et al.* 1981)
E. coli (generic)	Wheat	Wheat germ	43	3 MPN/g	11%	10^0 MPN/g	Australia	2003	(Berghofer *et al.* 2003)
E. coli (generic)	Wheat (durum)	Flour	984	NR	17.0%	NR	U.S.	1993	(Richter *et al.* 1993)
E. coli (generic)	Wheat (durum)	Flour	268	NR	NR	0.18 ± 0.29 log MPN/g	North America	2007	(Sperber *et al.* 2007)
E. coli (generic)	Wheat (durum)	Flour	227	NR	NR	0.82 ± 0.33 log CFU/g	North America	2007	(Sperber *et al.* 2007)
E. coli (generic)	Wheat (hard red winter)	Flour	796	NR	6.7%	NR	U.S.	1993	(Richter *et al.* 1993)
E. coli (generic)	Wheat (soft red winter)	Flour	1386	NR	13.4%	NR	U.S.	1993	(Richter *et al.* 1993)

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E. coli (generic)	Wheat (spring)	Flour	184	NR	12.5%	NR	U.S.	1993	(Richter *et al.* 1993)
E. coli EHEC	Wheat	Various types of raw wheat	3891	NR	0.44%	0.039 ±0.175 MPN/g	U.S.	2019	(Myoda *et al.* 2019)
E. coli O157:H7	Wheat	Various types of raw wheat	3891	NR	0%	NA	U.S.	2019	(Myoda *et al.* 2019)
E. coli O157:H7	Wheat (hard red winter)	Raw wheat	54	NR	0%	NA	Nebraska, U.S.	2016 (2012 season)	(Sabillón *et al.* 2016)
E. coli O157:H7	Wheat (hard red winter)	Raw wheat	54	NR	0%	NA	Nebraska, U.S.	2016 (2013 season)	(Sabillón *et al.* 2016)
E. coli STEC	Cereal grasses	Unspecified	243	NR; PCR-based method	0.4%	NR	Germany	2020	(Budesinstitut fur Risikobewertung 2020)
E. coli STEC	Wheat	Flour obtained in retail markets (**not from the recall**)	8	NR; PCR-based detection method	0%	NA (but recalled flour samples did have STEC present at 0.15 to 0.43 MPN/100 g)	Canada	2019	(Gill *et al.* 2019)
E. coli STEC	Wheat	Wheat grains collected at harvest	625	NR; PCR-based detection method	1.6%	NR	U.S.	2021	(Remfry *et al.* 2021)
E. coli STEC	Wheat and other grains	Flour obtained in retail markets	93	NR; PCR-based method	8.6%	NR	Switzerland	2019	(Boss *et al.* 2019)
E. coli STEC	Wheat and rye	Flour	98	NR; PCR-based method	39%	NR	Germany	2017	(Mäde *et al.* 2017)
E. coli STEC	Wheat, spelt, and rye	Flour	328	NR; PCR-based method	15.2%	NR	Germany	2020	(Budesinstitut fur Risikobewertung 2020)
E. coli STEC	Wheat, spelt, rye, buckwheat, and others	Flour	70	NR	12.9%	NR	Switzerland	2019	(Kindle *et al.* 2019)
Enterobacteriaceae	Buckwheat and maize	Flour	NR	NR	NR	3 to 5 log CFU/g	Italy	2017	(Losio *et al.* 2017)
Enterobacteriaceae	Millet	Malt	4	NR	NR	2.3×10^6 to 1.0×10^7 CFU/g	Zimbabwe	2019	(Pswarayi *et al.* 2019)
Enterobacteriaceae	Wheat	Flour	10	NR	NR	<1 log CFU/g	Spain	1999	(Cordoba *et al.* 1999)
Enterobacteriaceae	Wheat (durum)	Flour	NR	NR	NR	~4.2 log CFU/g	Italy	2016	(Celano *et al.* 2016)
Enterobacteriaceae	Wheat (hard red winter)	Raw wheat	54	10 CFU/g	NR	1.51 to 5.30 log CFU/g	Nebraska, U.S.	2016 (2012 season)	(Sabillón *et al.* 2016)
Enterobacteriaceae	Wheat (hard red winter)	Raw wheat	54	10 CFU/g	NR	2.87 to 5.47 log CFU/g	Nebraska, U.S.	2016 (2013 season)	(Sabillón *et al.* 2016)
Enterobacteriaceae	Wheat (soft white winter)	Grain	NR	NR	NR	4.60 ± 0.25 log CFU/g	U.S.	2019	(Thomas-Popo *et al.* 2019)

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Listeria monocytogenes	Wheat	Various types of raw wheat	1285	NR	0%	NA	U.S.	2019	(Myoda *et al.* 2019)
Listeria spp.	Wheat	Various types of raw wheat	1285	NR	0.08%	0.020 MPN/g	U.S.	2019	(Myoda *et al.* 2019)
Salmonella spp.	Corn	Animal feed ingredient	19	NR	5.26%	3.25 ± 0.44 log CFU/g	U.S.	2004	(Jones *et al.* 2004)
Salmonella spp.	Corn	Corn gluten meal for animal feed	8	NR	0%	NA	U.S.	2021	(Munoz *et al.* 2021)
Salmonella spp.	Corn	Corn meal for animal feed	40	NR	0%	NA	U.S.	2021	(Munoz *et al.* 2021)
Salmonella spp.	Corn	Flour	24	NR	0%	NA	U.S.	1974	(Bothast *et al.* 1974)
Salmonella spp.	Corn	Grits	24	NR	0%	NA	U.S.	1974	(Bothast *et al.* 1974)
Salmonella spp.	Corn	Milled cereal grains	1772	NR	0%	NR	North America	2007	(Sperber *et al.* 2007)
Salmonella spp.	Corn	Whole kernels	24	NR	0%	NA	U.S.	1974	(Bothast *et al.* 1974)
Salmonella spp.	Oat	Milled cereal grains	714	NR	0%	NR	North America	2007	(Sperber *et al.* 2007)
Salmonella spp.	Rye	Flour, refined	2	NR	0%	<LOQ	Portugal	2019	(Cardoso *et al.* 2019)
Salmonella spp.	Rye	Flour, whole rye	2	NR	0%	<LOQ	Portugal	2019	(Cardoso *et al.* 2019)
Salmonella spp.	Wheat	Animal feed ingredient	4	NR	0%	NA	U.S.	2021	(Munoz *et al.* 2021)
Salmonella spp.	Wheat	Animal feed ingredient	1	NR	0%	NA	U.S.	2004	(Jones *et al.* 2004)
Salmonella spp.	Wheat	Flour	150	NR	<0.7% (none)	NA	Queensland, Australia	2010	(Eglezos 2010)
Salmonella spp.	Wheat	Flour	1170	NR	0.34%	NR	Not reported	2007	(Sperber *et al.* 2007), citing data from a 2003 report
Salmonella spp.	Wheat	Flour, bran, or wheat germ	≤168	NR	0%	NA	Australia	2003	(Berghofer *et al.* 2003)
Salmonella spp.	Wheat	Flour, refined	2	NR	0%	<LOQ	Portugal	2019	(Cardoso *et al.* 2019)
Salmonella spp.	Wheat	Flour, whole wheat	1	NR	0%	<LOQ	Portugal	2019	(Cardoso *et al.* 2019)
Salmonella spp.	Wheat	Grain	50	NR	2%	NR	Queensland, Australia	2010	(Eglezos 2010)
Salmonella spp.	Wheat	Milled cereal grains	4358	NR	0.14%	NR	North America	2007	(Sperber *et al.* 2007)
Salmonella spp.	Wheat (durum)	Milled cereal grains	180	NR	0%	NR	North America	2007	(Sperber *et al.* 2007)
Salmonella spp.	Wheat	Milling samples	412	NR	<0.5%	NR	Australia	2003	(Berghofer *et al.* 2003)
Salmonella spp.	Wheat	Pasta (some with egg)	654	NR	0.5%	NR	Canada (including imports)	1981	(Rayman *et al.* 1981)
Salmonella spp.	Wheat	Various types of raw wheat	3891	NR	1.23%	0.110 ± 0.448 MPN/g	U.S.	2019	(Myoda *et al.* 2019)
Salmonella spp.	Wheat (durum)	Flour	816	NR	0.25%	NR	U.S.	1993	(Richter *et al.* 1993)

Bacteria	Grain	Food Product	Number of Samples Tested	Detection Level (CFU or MPN/g)	Prevalence (percentage of positive samples)	Microbiological levels	Geographic Region	Year Published	Reference
Salmonella spp.	Wheat (hard red winter)	Flour	681	NR	0.73%	NR	U.S.	1993	(Richter *et al.* 1993)
Salmonella spp.	Wheat (hard red winter)	Raw wheat	54	NR	0%	NA	Nebraska, U.S.	2016 (2012 season)	(Sabillón *et al.* 2016)
Salmonella spp.	Wheat (hard red winter)	Raw wheat	54	NR	0%	NA	Nebraska, U.S.	2016 (2013 season)	(Sabillón *et al.* 2016)
Salmonella spp.	Wheat (soft red winter)	Flour	1355	NR	2.29%	NR	U.S.	1993	(Richter *et al.* 1993)
Salmonella spp.	Wheat (spring)	Flour	188	NR	1.06%	NR	U.S.	1993	(Richter *et al.* 1993)
Salmonella spp.	Wheat (whole)	Milled cereal grains	286	NR	0%	NR	North America	2007	(Sperber *et al.* 2007)
Salmonella spp.	Wheat middlings	Animal feed ingredient	24	NR	4.17%	4.10 ± 0.28 log CFU/g	U.S.	2004	(Jones *et al.* 2004)
Staphylococcus aureus (coagulase positive)	Buckwheat	Flour	8	NR	75%	NR	Italy	2017	(Losio *et al.* 2017)
Staphylococcus aureus (coagulase positive)	Maize	Flour	23	NR	21.7%	NR	Italy	2017	(Losio *et al.* 2017)
Staphylococcus aureus (coagulase positive)	Wheat	Pasta (no egg)	1212	>25 CFU/g	4.3%	$<2.5 \times 10^4$ CFU/g	Canada	1981	(Rayman *et al.* 1981)
Staphylococcus aureus (coagulase positive)	Wheat	Pasta (no egg)	288	>25 CFU/g	0%	NA	Imported into Canada	1981	(Rayman *et al.* 1981)
Staphylococcus spp.	Wheat	Flour	15	1 log CFU/g	NR	<1 log CFU/g	Spain	1999	(Cordoba *et al.* 1999)

NA: not applicable; NR: not reported; LOQ: limit of quantitation

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