**Animal Board Invited review: Comparing conventional and organic livestock production systems on different aspects of sustainability**

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**Supplement Table S5:** Reviewed studies comparing microbiological hazards in organic and conventional livestock production

| Reference | Hazard | Study country | Sample type / sample point | # units/samples: conventional (organic) | Unit | Value conven-tional | Value organic | Significance | Explanation observed differences |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Dairy cattle* |  |  |  |  |  |  |  |  |  |
| Bennedsgaard *et al.* (2006) | *Staphylococcus aureus* | Denmark | quarter milk / farm | 20 (18) herds, 30 cows per herd | cow prevalence (%) | 23 | 25 | p>0.05 | not mentioned |
| Bombyk *et al.* (2008) | *Staphylococcus* | USA (Minnesota) | composite quarter milk / farm | 8 (8) farms, 339 (501) cows | sample prevalence (%) | 49 | 47.7 | p>0.05 | different profiles of S types, due to pasture, fly bites, dry cow antibiotic treatment |
| Cho *et al.* (2006a) | Shiga Toxin-encoding bacteria | USA (Minnesota) | Fecal / farm | 20 (8) farms, 1 750 (458) samples | herd prevalence (%) | 66.7 | 87.5 | p=0.37 | Housing type, pasture access, feeding practices, age differences, season, culture methods |
| Cho *et al.* (2006a) | Shiga Toxin-encoding bacteria | USA (Minnesota) | fecal / farm | 20 (8) farms, 1 750 (458) samples | sample prevalence (%) | 4 | 6.6 | p=0.06 | Housing type, pasture access, feeding practices, age differences, season, culture methods |
| Cho *et al.* (2006a) | Shiga Toxigenic *Escherichia Coli* | USA (Minnesota) | fecal / farm | 20 (8) farms, 1 750 (458) samples | virulence genes prevalence (%) | - | - | p>0.05 | Housing type, pasture access, feeding practices, age differences, season, culture methods |
| Cho *et al.* (2006b) | *Escherichia Coli* O157 | USA (Minnesota) | rectal fecal / farm | 18 (8) farms, 271 (166) samples | sample prevalence (%) | 3 | 8.4 | p=0.15 | org: smaller herds size, tie stalls, lower rolling herd average, less likely affiliated with Dairy Herd Improvement Association; general: region, season, detection method |
| Coorevits *et al.* (2008) | spore forming bacteria (*Bacillus*) | Belgium | bulk milk tank / farm | 5 (5) farms | sample prevalence (%) | 56.3 | 43.7 | p<0.01 | seasonal variation, soil ingestion (less in winter or indoor), concentrated feed |
| Čuboň *et al.* (2008) | total bacteria count | Slovakia | bulk milk tank / farm | 1 (1) farm, 10 (10) samples | 1 000 CFU/ml | 51 | 86 | p=++ | not mentioned |
| Čuboň *et al.* (2008) | coliform organisms | Slovakia | bulk milk tank / farm | 1 (1) farm, 10 (10) samples | 1 000 CFU/ml | 269 | 554 | p=+ | not mentioned |
| Garmo *et al.* (2010) | *Staphylococcus aureus* | Norway | quarter milk of mastitis cows / farm | 25 (24) herds,2 092 (1 948) samples | sample prevalence (%) | 3.3 | 3.4 | p>0.05 | not mentioned |
| Garmo *et al.* (2010) | *Streptococcus dysgalactiae* | Norway | quarter milk of mastitis cows / farm | 25 (24) herds, 2 092 (1 948) samples | sample prevalence (%) | 1.3 | 1.7 | p>0.05 | conv: higher motivation to improve udder health and more use of dry cow therapy |
| Garmo *et al.* (2010) | *Streptococcus uberis* | Norway | quarter milk of mastitis cows / farm | 25 (24) herds, 2 092 (1 948) samples | sample prevalence (%) | 1.2 | 0.6 | p>0.05 | not mentioned |
| Garmo *et al.* (2010) | other *Streptococcus* | Norway | quarter milk of mastitis cows / farm | 25 (24) herds,2 092 (1 948) samples | sample prevalence (%) | 0.2 | 0.3 | p>0.05 | not mentioned |
| Garmo *et al.* (2010) | *Escherichia Coli* | Norway | quarter milk of mastitis cows / farm | 25 (24) herds,2 092 (1 948) samples | sample prevalence (%) | 0 | 0.2 | p>0.05 | not mentioned |
| Garmo *et al.* (2010) | *Enterococcus* spp. | Norway | quarter milk of mastitis cows / farm | 25 (24) herds, 2 092 (1 948) samples | sample prevalence (%) | 1.4 | 0.5 | p>0.05 | not mentioned |
| Garmo *et al.* (2010) | bacteria negative | Norway | quarter milk of mastitis cows / farm | 25 (24) herds, 2 092 (1 948) samples | sample prevalence (%) | 84.5 | 82.8 | p>0.05 | not mentioned |
| Kouřimská *et al.* (2014) | coliform bacteria count | Czech Republic | bulk milk tank / farm | 473 (101) samples | CFU/ml | 480 | 450 | p=0.682 | farm size, disinfection milking equipment |
| Kouřimská *et al.* (2014) | total mesophilic bacteria count | Czech Republic | bulk milk tank / farm | 1 168 (218) samples | 1 000 CFU/ml | 19 | 28 | p<0.001 | farm size, disinfection milking equipment |
| Kuhnert *et al.* (2005) | *Shiga Toxigenic Escherichia Coli* | Switzerland | rectal fecal / farm | 60 (60) farms, 485 (481) samples | farm prevalence (%) | 100 | 100 | not significant | not mentioned |
| Kuhnert *et al.* (2005) | *STEC* O157:H7 | Switzerland | rectal fecal / farm | 60 (60) farms, 485 (481) samples | farm prevalence (%) | 17 | 25 | not significant | not mentioned |
| Miranda *et al.* (2009a) | *Escherichia coli* | Spain | pasteurized cheese / supermarket | 67 (60) cheeses, 10 (12) samples of same brand | sample prevalence (%) | 86.6 | 71.7 | p>0.05 | heat treatment and hygiene during manufacture, packaging and handling more important than type of milk for pasteurized cheese |
| Miranda *et al.* (2009a) | *Staphylococcus aureus* | Spain | pasteurized cheese / supermarket | 67 (60) cheeses, 10 (12) samples of same brand | sample prevalence (%) | 74.6 | 83.3 | p>0.05 | heat treatment and hygiene during manufacture, packaging and handling more important than type of milk for pasteurized cheese |
| Miranda *et al.* (2009a) | *Salmonella* spp. | Spain | pasteurized cheese / supermarket | 67 (60) cheeses, 10 (12) samples of same brand | sample prevalence (%) | 97 | 100 | p>0.05 | heat treatment and hygiene during manufacture, packaging and handling more important than type of milk for pasteurized cheese |
| Miranda *et al.* (2009a) | *Listeria monocytogenes* | Spain | pasteurized cheese / supermarket | 67 (60) cheeses, 10 (12) samples of same brand | sample prevalence (%) | 98.5 | 100 | p>0.05 | heat treatment and hygiene during manufacture, packaging and handling more important than type of milk for pasteurized cheese |
| Sato *et al.* (2004a) | *Campylobacter* spp. | USA (Wisconsin) | Fecal / farm | 30 (30) neighbouring farms, 2 visits per farm | farm prevalence (%) | 29.1 | 26.7 | p=0.5253 | general: location, season, transport medium, time before processing, enrichment media, isolation method |
| Sato *et al.* (2004b) | *Staphylococcus aureus* | Denmark | bulk milk tank / farm | 20 (20) farms, 2 visits per farm | farm prevalence (%) | 85 | 50 | not provided | not mentioned |
| Sato *et al.* (2004b) | *Staphylococcus aureus* | USA (Wisconsin) | bulk milk tank / farm | 30 (30) neighbouring farms, 2 visits per farm | farm prevalence (%) | 73 | 87 | not provided | conventional farms somewhat larger |
| Sato *et al.* (2005) | *Escherichia Coli* | USA (Wisconsin) | rectal fecal / farm | 30 (30) neighbouring farms, 20 samples per farm | sample prevalence (%) | 95.8 | 92.4 | p>0.05 | not mentioned |
| Silverlås and Blanco-Penedo (2013) | *Cryptosporidium* spp. | Sweden | rectal fecal / farm | 13 (13) herds, 107 (114) calves | herd prevalence calves (%) | 52.3 | 44.7 | p>0.05 | weather conditions, attitude towards biosecurity, livestock renewal strategy |
| Silverlås and Blanco-Penedo (2013) | *Cryptosporidium* spp. | Sweden | rectal fecal / farm | 13 (13) herds, 130 (129) calves | herd prevalence cows (%) | 3.8 | 3.1 | p>0.05 | weather conditions, attitude towards biosecurity, livestock renewal strategy |
| Tikofsky *et al.* (2003) | *Staphylococcus aureus* | USA (New York, Vermont) | composite quarter milk / farm | 16 (22) herds | sample prevalence (%) | 21.86 | 15.94 | p=0.161 | not mentioned |
|  |  |  |  |  |  |  |  |  |  |
| *Beef cattle* |  |  |  |  |  |  |  |  |  |
| Blanco-Penedo *et al.* (2009) | liver condemnations | Spain | Liver / slaughter house | 3 021 (244) calves | calf prevalence (%) | 16.8 | 10.7 | p=0.000 | org: abscesses: low fraction of concentrate in ration; less crowded pens. Parasites: org: hygiene level, grazing |
| Blanco-Penedo *et al.* (2009) | lung condemnations | Spain | lung / slaughter house | 3 021 (244) calves | calf prevalence (%) | 35.2 | 23.8 | p=0.000 | conv: more crowded pens; bad indoor climate |
| Blanco-Penedo *et al.* (2009) | kidney condemnations | Spain | Kidney / slaughter house | 3 021 (244) calves | calf prevalence (%) | 11.2 | 3.7 | p=0.000 | not mentioned |
| Blanco-Penedo *et al.* (2009) | digestive tract condemnations | Spain | digestive tract / slaughter house | 3 021 (244) calves | calf prevalence (%) | 8.1 | 32 | p=0.000 | org: feeding behaviour, feed supply outdoor |
| Blanco-Penedo *et al.* (2009) | heart condemnations | Spain | heart / slaughter house | 3 021 (244) calves | calf prevalence (%) | 0.5 | 0.4 | p=0.849 | not mentioned |
| Blanco-Penedo *et al.* (2009) | leg condemnations | Spain | leg / slaughter house | 3 021 (244) calves | calf prevalence (%) | 0.2 | 0.8 | p=0.039 | not mentioned |
| Guarddon *et al.* (2014) | Mesophilic aerobic bacteria | Spain | beef steaks / supermarket | 18 supermarkets, 2 organic retail stores, 30 (30) steaks | log CFU/g | 5 | 5.9 | p<0.05 | not mentioned |
| Guarddon *et al.* (2014) | Enterobacteriaceae | Spain | beef steaks / supermarket | 18 supermarkets, 2 organic retail stores, 30 (30) steaks | log CFU/g | 3 | 3.4 | p>0.05 | not mentioned |
| Miranda *et al.* (2009b) | *Escherichia coli* | ? Spain | packaged beef / supermarket | 75 (75) packages | sample prevalence (%) | 42.7 | 48 | p=0.6227 | no difference due to contamination at slaughter houses and processing and via food handlers |
| Miranda *et al.* (2009b) | *Staphylococcus aureus* | ? Spain | packaged beef / supermarket | 75 (75) packages | sample prevalence (%) | 54.7 | 50.7 | p=0.7436 | no difference due to contamination at slaughter houses and processing and via food handlers |
| Miranda *et al.* (2009b) | *Listeria monocytogenes* | ? Spain | packaged beef / supermarket | 75 (75) packages | sample prevalence (%) | 29.3 | 36 | p=0.4862 | no difference due to contamination at slaughter houses and processing and via food handlers |
| Miranda *et al.* (2009b) | *Salmonella* spp. | ? Spain | packaged beef / supermarket | 75 (75) packages | sample prevalence (%) | 0 | 0 | n.d. | no difference due to contamination at slaughter houses and processing and via food handlers |
|  |  |  |  |  |  |  |  |  |  |
| *Pigs* |  |  |  |  |  |  |  |  |  |
| Bonde and Sørensen (2012) | *Salmonella* | Denmark | fecal / farm | 11 (11) herds, 449 (534) animals | pig prevalence (%) | 2.4 | 0.2 | p=0.13 | org: infection early in life, so no more shedding just before slaughter, more resistance |
| Bonde and Sørensen (2012) | *Salmonella* | Denmark | fecal / farm | 11 (11) herds, 449 (534) animals | pig prevalence at abattoir (%) | 4.2 | 1.9 | p=0.82 | org: infection early in life, so no more shedding just before slaughter, more resistance |
| Bonde and Sørensen (2012) | *Salmonella* | Denmark | meat juice / slaughter house | 11 (11) herds, 449 (534) animals | pig prevalence meat juice (%) | 4.2 | 7.1 | p=0.88 | org: infection early in life, so no more shedding just before slaughter, more resistance |
| Guarddon *et al.* (2014) | mesophilic aerobic bacteria | Spain | Steaks / supermarket | 18 supermarkets, 2 organic retail stores, 40 (40) steaks | log CFU/g | 4.7 | 5.1 | p>0.05 | not mentioned |
| Guarddon *et al.* (2014) | Enterobacteriaceae | Spain | Steaks / supermarket | 18 supermarkets, 2 organic retail stores, 40 (40) steaks | log CFU/g | 3 | 2.8 | p>0.05 | not mentioned |
| Hellström *et al.* (2010) | *Listeria monocytogenes* | Finland | rectal swap / farm | 10 (5) farms, 21 to 26 pigs per farm | pig prevalence (%) | 0 | 3 | p<0.01 | org: large group size (more pig-pig contact), access to outdoor, coarse feed (also between farms: treatment manure, hygiene practices, drinking from through) |
| Hellström *et al.* (2010) | *Listeria monocytogenes* | Finland | intestinal tract / slaughter house | 10 (5) farms, 21 to 26 pigs per farm | intestinal tract prevalence (%) | 0 | 3 | p<0.01 | Org: lack of proper cleaning and disinfection and good operating protocols at slaughter plant; environment in cutting plant |
| Hellström *et al.* (2010) | *Listeria monocytogenes* | Finland | Tonsil / slaughter house | 10 (5) farms, 21 to 26 pigs per farm | tonsil prevalence (%) | 12 | 47 | p<0.01 | Org: lack of proper cleaning and disinfection and good operating protocols at slaughter plant; environment in cutting plant |
| Hellström *et al.* (2010) | *Listeria monocytogenes* | Finland | pluck set / slaughter house | 10 (5) farms, 21 to 26 pigs per farm | pluck set prevalence (%) | 1 | 13 | p<0.01 | Org: lack of proper cleaning and disinfection and good operating protocols at slaughter plant; environment in cutting plant |
| Hellström *et al.* (2010) | *Listeria monocytogenes* | Finland | carcass / slaughter house | 10 (5) farms, 21 to 26 pigs per farm | carcass prevalence (%) | 0 | 2 | p<0.01 | Org: lack of proper cleaning and disinfection and good operating protocols at slaughter plant; environment in cutting plant |
| Hoogenboom *et al.* (2008) | *Salmonella* | Netherlands | fecal / farm | national (30) farms, (12 pigs per farm) | pig faeces sample prevalence (%) | 0 | 27 | similar to conventional | org: positive farms were recently switched to organic (7 of 8) and the other was a stable with piglets bought elsewhere |
| Hoogenboom *et al.* (2008) | *Campylobacter* | Netherlands | fecal / farm | national (30) farms, (12 pigs per farm) | pig faeces sample prevalence (%) | 0 | 56 | similar to conventional | not mentioned |
| Laukkanen *et al.* (2008) | *Yersinia pseudotuberculosis* | Finland | rectal swap / farm | 10 (5) farms, 21 to 26 pigs/farm | pig prevalence (%) | 3 | 19 | p<0.05 | org: more contact with pest and pet animals and outside environment; between-farm: number of pigs, drinking troughs |
| Laukkanen *et al.* (2008) | *Yersinia pseudotuberculosis* | Finland | rectal swap / farm | 10 (5) farms, 21 to 26 pigs/farm | sample prevalence (%) | 3 | 19 | not mentioned | org: more contact with pest and pet animals and outside environment; between-farm: number of pigs, drinking troughs |
| Laukkanen *et al.* (2008) | *Yersinia pseudotuberculosis* | Finland | intestinal tract / slaughter house | 10 (5) farms, 21 to 26 pigs/farm, 239 (119) swaps | intestinal tract prevalence (%) | 5 | 9 | not mentioned | org: more contact with pest and pet animals and outside environment; between-farm: number of pigs, drinking troughs |
| Laukkanen *et al.* (2008) | *Yersinia pseudotuberculosis* | Finland | tonsil / slaughter house | 10 (5) farms, 21 to 26 pigs/farm, 231 (119) swaps | tonsil prevalence (%) | 3 | 24 | not mentioned | org: more contact with pest and pet animals and outside environment; between-farm: number of pigs, drinking troughs |
| Laukkanen *et al.* (2008) | *Yersinia pseudotuberculosis* | Finland | pluck set / slaughter house | 10 (5) farms, 21 to 26 pigs/farm, 234 (120) swaps | pluck set prevalence (%) | 0.4 | 4 | not mentioned | org: more contact with pest and pet animals and outside environment; between-farm: number of pigs, drinking troughs |
| Laukkanen *et al.* (2008) | *Yersinia pseudotuberculosis* | Finland | carcass swap / slaughter house | 10 (5) farms, 21 to 26 pigs/farm, 239 (120) swaps | carcass prevalence (%) | 0 | 8 | not mentioned | org: more contact with pest and pet animals and outside environment; between-farm: number of pigs, drinking troughs |
| Miranda *et al.* (2008a) | *Escherichia coli* | Spain | Loin / supermarket | 14 (3) brands, 67 (54) loins | sample prevalence (%) | 47.8 | 64.8 | p=0.0231 | use of antimicrobial agents in conventional |
| Miranda *et al.* (2008a) | *Escherichia coli* | Spain | Loin / supermarket | 14 (3) brands, 67 (54) loins | sample prevalence with load >2 log cfu/g (%) | 3 | 16.7 | p=0.0231 | use of antimicrobial agents in conventional |
| Nowak *et al.* (2006) | *Yersinia enterocolitica* | Germany | rectal swap / farm | 6 (3) farms, 210 (200) pigs | pig prevalence (%) | 29 | 18 | p=0.014 | conv: varying piglet suppliers, commercial feed and transport to slaughterhouse; different slaughterhouses (cross-contamination risk), all slaughtered early in morning (later, more risk due to higher probability intake faeces other animals) |
| Nowak *et al.* (2006) | *Yersinia enterocolitica* | Germany | tonsil / slaughter house | 6 (3) farms, 210 (200) pigs | tonsil prevalence (%) | 22 | 11 | p=0.025 | conv: varying piglet suppliers, commercial feed and transport to slaughterhouse; different slaughterhouses (cross-contamination risk), all slaughtered early in morning (later, more risk due to higher probability intake faeces other animals) |
| Nowak *et al.* (2006) | *Yersinia enterocolitica* | Germany | Caecum / slaughter house | 6 (3) farms, 210 (200) pigs | caecal prevalence (%) | 10 | 5 | p=0.243 | conv: varying piglet suppliers, commercial feed and transport to slaughterhouse; different slaughterhouses (cross-contamination risk), all slaughtered early in morning (later, more risk due to higher probability intake faeces other animals) |
| Nowak *et al.* (2006) | *Yersinia enterocolitica* | Germany | lymph nodes / slaughter house | 6 (3) farms, 210 (200) pigs | lymph nodes prevalence (%) | 7 | 2 | p=0.049 | conv: varying piglet suppliers, commercial feed and transport to slaughterhouse; different slaughterhouses (cross-contamination risk), all slaughtered early in morning (later, more risk due to higher probability intake faeces other animals) |
| Ranta *et al.* (2010) | *Listeria monocytogenes*, *Yersinia enterocolitica*, *Yersinia pseudotuberculosis* | Finland | fecal / farm | 10 (5) farms, about 25 pigs per farm | sample prevalence (%) | - | - | small conventional less than large conventional and organic | not mentioned |
| Rutjes *et al.* (2014) | Hepatitis E virus | Netherlands | Blood / farm | 24 (42) farms, 265 (417) pigs | pig sero-prevalence (%) | 72 | 89 | p=0.04 | feed supply, org: more repetitive exposure due to housing conditions e.g. more contact frequency between pigs, more exposure to manure |
| Rutjes *et al.* (2014) | Hepatitis E virus | Netherlands | Blood / farm | 24 (42) farms, 265 (417) pigs | farm prevalence (%) | 100 | 98 | not provided | feed supply, org: more repetitive exposure due to housing conditions e.g. more contact frequency between pigs, more exposure to manure |
| Rutjes *et al.* (2014) | Hepatitis E virus | Netherlands | Blood / farm | 24 (42) farms, 265 (417) pigs | per cent farms with pig seroprevalence > 95% | 40 | 60 | not provided | feed supply, org: more repetitive exposure due to housing conditions e.g. more contact frequency between pigs, more exposure to manure |
|  |  |  |  |  |  |  |  |  |  |
| *Broilers* |  |  |  |  |  |  |  |  |  |
| Alali *et al.* (2010) | *Salmonella* spp. | USA (North Carolina) | fecal droppings / farm | 4 (3) farms from 1 company, 1 house each farm, 2 flocks per house, 15 samples per flock | fecal sample prevalence (%) | 38.8 | 5.6 | p<0.0001 | conv: salmonella contaminated feed, different breeder flocks,  |
| Alali *et al.* (2010) | *Salmonella* spp. | USA (North Carolina) | Feed / farm | 4 (3) farms from 1 company, 1 house each farm, 2 flocks per house, 5 samples per flock | feed sample prevalence (%) | 27.5 | 5 | p=0.007 | conv: salmonella contaminated feed, different breeder flocks,  |
| Alali *et al.* (2010) | *Salmonella* spp. | USA (North Carolina) | Water / farm | 4 (3) farms from 1 company, 1 house each farm, 2 flocks per house, 5 samples per flock | water sample prevalence (%) | 0 | 0 | no difference | conv: salmonella contaminated feed, different breeder flocks,  |
| Álvarez-Fernández *et al.* (2013) | Psychotrophs (indicator for keeping quality) | Spain | Carcass / supermarket | 8 retail outlets, 30 (30) carcasses | log CFU/g skin | 4.97 | 5.73 | p<0.05 | not mentioned |
| Álvarez-Fernández *et al.* (2013) | Faecal coliforms | Spain | Carcass / supermarket | 8 retail outlets, 30 (30) carcasses | log CFU/g skin | 2.95 | 2.07 | p<0.05 | not mentioned |
| Cui *et al.* (2005) | *Salmonella* spp. | USA (Maryland) | Carcass / supermarket | 3 (3) retail stores, 61 (198) carcasses | sample prevalence (%) | 44 | 61 | not provided | not mentioned |
| Cui *et al.* (2005) | *Campylobacter* spp. | USA (Maryland) | Carcass / supermarket | 3 (3) retail stores, 61 (198) carcasses | sample prevalence (%) | 74 | 76 | not provided | not mentioned |
| Guarddon *et al.* (2014) | Mesophilic aerobic bacteria | Spain | Thighs / supermarket | 18 supermarkets, 2 organic retail stores, 30 (30) thighs | log CFU/g | 5.3 | 4.7 | p>0.05 | not mentioned |
| Guarddon *et al.* (2014) | Enterobacteriaceae | Spain | Thighs / supermarket | 18 supermarkets, 2 organic retail stores, 30 (30) thighs | log CFU/g | 3.7 | 2.8 | p<0.05 | not mentioned |
| Han *et al.* (2009) | *Campylobacter* spp. | USA (Louisiana) | Carcass / supermarket | 26 (1) retail stores, 141 (53) carcasses | sample prevalence (%) | 43.3 | 43.4 | p>0.05 | geographical region, chicken producer |
| Hardy *et al.* (2013) | Aerobic bacteria | USA (Tennessee) | whole broiler carcass / supermarket | 2 (2) brands, 50 (50) carcasses | log cfu/g | - | - | one organic brand highest, other organic brand lowest, 2 conventional brands in between | not mentioned |
| Hardy *et al.* (2013) | *Campylobacter* spp. | USA (Tennessee) | whole broiler carcass / supermarket | 2 (2) brands, 50 (50) carcasses | log cfu/g | - | - | one organic brand highest, other organic brand lowest, 2 conventional brands in between | org: longer rearing period, so more time to colonize; higher vulnerability of breed; more contact with other animals and birds |
| Hardy *et al.* (2013) | *Salmonella* spp. | USA (Tennessee) | whole broiler carcass / supermarket | 2 (2) brands, 50 (50) carcasses | sample prevalence (%) | 0 | 5 | p>0.05 | not mentioned |
| Hardy *et al.* (2013) | *Staphylococcus* spp. | USA (Tennessee) | whole broiler carcass / supermarket | 2 (2) brands, 50 (50) carcasses | log cfu/g | - | - | one organic brand highest, other organic brand lowest, 2 conventional brands in between | unclear why difference |
| Heuer *et al.* (2001) | *Campylobacter* spp. | Denmark | cloacal swap / farm | 18 (12) farms, 79 (22) flocks, 10 boilers per flock | flock prevalence (%) | 36.7 | 100 | p<0.001 | org: access to soil and water in the open, high age at slaughter (slow growing breed), other breed |
| Heuer *et al.* (2001) | *Campylobacter* spp. | Denmark | cloacal swap / farm | 18 (12) farms, 79 (22) flocks, 10 boilers per flock | broiler prevalence (%) | 60 | 65 | no significant difference | not mentioned |
| Hoogenboom *et al.* (2008) | *Campylobacter* spp. | Netherlands | Faeces / farm | national average (9) farms, national average (45) samples | farm prevalence (%) | 0 | 100 | conventional much lower | not mentioned |
| Hoogenboom *et al.* (2008) | *Campylobacter* spp. | Netherlands | Faeces / farm | national average (9) farms, national average (45) samples | sample prevalence (%) | 0 | 71.1 | conventional much lower | not mentioned |
| Lestari *et al.* (2009) | *Salmonella* spp. | USA (Louisiana) | Carcass / supermarket | 26 (1) retail stores, 141 (53) carcasses | sample prevalence (%) | 22 | 20.8 | p>0.05 | larger slaughter house less contamination, test methodology, nature of sample, location in supply chain |
| Luangtongkum *et al.* (2006) | *Campylobacter* spp. | USA (Ohio) | intestinal tract / slaughter house | 8 (5) farms, 345 (355) tracts | farm prevalence (%) | 100 | 100 | not provided | not mentioned |
| Luangtongkum *et al.* (2006) | *Campylobacter* spp. | USA (Ohio) | intestinal tract / slaughter house | 9 (5) farms, 345 (355) tracts | sample prevalence (%) | 65.8 | 89.3 | p<0.05 | org: 2 to 4 weeks older birds |
| Luangtongkum *et al.* (2006) | *Campylobacter jejuni* | USA (Ohio) | intestinal tract / slaughter house | 10 (5) farms, 345 (355) tracts | sample prevalence (%) | 63.8 | 64.5 | not provided | not mentioned |
| Luangtongkum *et al.* (2006) | *Campylobacter coli* | USA (Ohio) | intestinal tract / slaughter house | 10 (5) farms, 345 (355) tracts | sample prevalence (%) | 2 | 24.8 | not provided | not mentioned |
| Mazengia *et al.* (2014) | *Salmonella* spp. | USA (Washington state) | raw chicken packages / supermarket | 1094 (228) packages | sample prevalence (%) | 10.5 | 15.4 | p=0.0394 | sample taking, handling of poultry carcasses during slaughtering |
| Miranda *et al.* (2007) | *Enterococcus* spp. | Spain | skin-on drumsticks / supermarket | 30 (5) supermarkets, 30 (30) drumsticks | log cfu/g | 2.06 | 3.18 | p=0.0002 | org: less antibiotic use |
| Miranda *et al.* (2008b) | *Escherichia coli* | Spain | skin-on drumsticks / supermarket | 12 (5) supermarkets, 61 (55) drumsticks | sample prevalence (%) | 62.3 | 81.8 | p<0.05 | not mentioned |
| Miranda *et al.* (2008b) | *Escherichia coli* | Spain | skin-on drumsticks / supermarket | 12 (5) supermarkets, 61 (55) drumsticks | positive sample log cfu/g | 1.36 | 1.82 | p=0.0001 | not mentioned |
| Miranda *et al.* (2008b) | *Staphylococcus aureus* | Spain | skin-on drumsticks / supermarket | 12 (5) supermarkets, 61 (55) drumsticks | sample prevalence (%) | 41 | 49.1 | both p<0.05 and p>0.05 mentioned | food handlers maybe more important than contamination from farm |
| Miranda *et al.* (2008b) | *Staphylococcus aureus* | Spain | skin-on drumsticks / supermarket | 12 (5) supermarkets, 61 (55) drumsticks | positive sample log cfu/g | 0.785 | 0.942 | p=0.6917 | food handlers maybe more important than contamination from farm |
| Miranda *et al.* (2008b) | *Listeria monocytogenes* | Spain | skin-on drumsticks / supermarket | 12 (5) supermarkets, 61 (55) drumsticks | sample prevalence (%) | 57.3 | 67.3 | p>0.05 | food handlers maybe more important than contamination from farm |
| Miranda *et al.* (2008b) | *Listeria monocytogenes* | Spain | skin-on drumsticks / supermarket | 12 (5) supermarkets, 61 (55) drumsticks | positive sample log cfu/g | 2.13 | 2.15 | p=0.2756 | food handlers maybe more important than contamination from farm |
| Miranda *et al.* (2008c) | Enterobacteriaceae | Spain | skin-on drumsticks / supermarket | 30 (5) supermarkets, 30 (30) drumsticks | log cfu/g | 2.66 | 3.81 | p<0.0001 | special characteristics of organic farming |
| Mollenkopf *et al.* (2014) | *Salmonella* spp. | USA (Ohio, Michigan, Pennsylvania) | chicken breast / supermarket | 27 processing plants, 17 store chains, 99 stores, 95 (40) breasts | sample prevalence (%) | 25 | 18 | no differences | origin contamination hatchery, parent stock, management slaughter/processing plant |
| Mollenkopf *et al.* (2014) | *Campylobacter* spp. | USA (Ohio, Michigan, Pennsylvania) | chicken breast / supermarket | 27 processing plants, 17 store chains, 99 stores, 95 (40) breasts | sample prevalence (%) | 13 | 5 | no differences | origin contamination hatchery, parent stock, management slaughter/processing plant |
| Pieskus *et al.* (2008) | *Salmonella* spp. | Netherlands | dust, litter, water caecum / farm | 18 (108) flocks, 771 (439) samples | flock prevalence (%) | 11 | 3.7 | not provided | org: slow growing, so at slaughter shedding below detection |
| Pieskus *et al.* (2008) | *Salmonella* spp. | Italy | dust, litter, water caecum / farm | 10 (11) flocks, 110 (100) samples | flock prevalence (%) | 20 | 18.1 | not provided | not provided |
| Rosenquist *et al.* (2013) | *Campylobacter* spp. | Denmark | carcass after chilling / processing | 228 (52) flocks, 228 (208) carcasses | carcass prevalence (%) | 19.7 | 54.2 | significant | org: earlier exposure through outdoor environment, so less shedding at slaughter |
| Rosenquist *et al.* (2013) | *Campylobacter* spp. | Denmark | carcass after chilling / processing | 228 (52) flocks, 228 (208) carcasses | mean concentration on positive carcasses (log(10) cfu/g) | 2.1 | 2 | p=0.428 | org: earlier exposure through outdoor environment, so less shedding at slaughter |
| Sapkota *et al.* (2014) | *Salmonella* spp. | USA (Mid-Atlantic states) | litter, water, feed / farm | 5 (5) farms, 2 houses each farm, 3/2/1 litter/water/feed samples per house | poultry house prevalence (%) | 30 | 80 | p=0.03 | different states, farm management, feed practices and season; org.: relatively high density |
| Sapkota *et al.* (2014) | *Salmonella* spp. | USA (Mid-Atlantic states) | litter, water, feed / farm | 5 (5) farms, 2 houses each farm, 3/2/1 litter/water/feed samples per house | farm prevalence (%) | 40 | 100 | not provided | different states, farm management, feed practices and season; org.: relatively high density |
| Sapkota *et al.* (2014) | Enterococcus spp. | USA (Mid-Atlantic states) | litter, water, feed / farm | 5 (5) farms, 2 houses each farm, 3/2/1 litter/water/feed samples per house | poultry house prevalence (%) | 100 | 100 | no difference | not mentioned |
| Van Overbeke *et al.* (2006) | *Salmonella* spp. | Belgium | hatching papers, overshoes / farm | 11 (9) farms from 1 integration | flock prevalence (%) | 0 | 0 | no significant difference | org: higher: outdoor access, less use antimicrobials; lower: older slaughter, less stress for animals, higher resistance because older at challenge |
| Van Overbeke *et al.* (2006) | *Campylobacter* spp. | Belgium | hatching papers, cecal droppings / farm | 11 (9) farms from 1 integration | flock prevalence (%) | 0 | 0 | no significant difference | org: higher: exposure soil/water in outdoor environment, longer rearing period, more susceptible breed |
| Van Overbeke *et al.* (2006) | *Salmonella* spp. | Belgium | gastrointestinal tract / slaughter house | 11 (9) farms from 1 integration, 30 (30) broilers | gastrointestinal tract prevalence (%) | 0 | 0 | no significant difference | org: higher: outdoor access, less use antimicrobials; lower: older slaughter, less stress for animals, higher resistance because older at challenge |
| Van Overbeke *et al.* (2006) | *Campylobacter* spp. | Belgium | gastrointestinal tract / slaughter house | 11 (9) farms from 1 integration, 30 (30) broilers | cecum prevalence (%) | 28 | 75 | p=0.024 | org: higher: exposure soil/water in outdoor environment, longer rearing period, more susceptible breed |
| Van Overbeke *et al.* (2006) | *Campylobacter* spp. | Belgium | gastrointestinal tract / slaughter house | 11 (9) farms from 1 integration, 30 (30) broilers | duodenum prevalence (%) | 18 | 75 | p=0.036 | org: higher: exposure soil/water in outdoor environment, longer rearing period, more susceptible breed |
|  |  |  |  |  |  |  |  |  |  |
| *Laying hens (hen)* |  |  |  |  |  |  |  |  |  |
| Álvarez-Fernández *et al.* (2012) | aerobic bacteria | Spain | egg shell / supermarket | 10 (10) boxes with 12 eggs, 40 (40) eggs | log cfu/square cm | 2.34 | 2.25 | p>0.05 | farm construction, management, handling in supply chain |
| Álvarez-Fernández *et al.* (2012) | Psychotrophs | Spain | egg shell / supermarket | 10 (10) boxes with 12 eggs, 40 (40) eggs | log cfu/square cm | 1.54 | 1.41 | p>0.05 | farm construction, management, handling in supply chain |
| Álvarez-Fernández *et al.* (2012) | Enterobacteriaceae | Spain | egg shell / supermarket | 10 (10) boxes with 12 eggs, 40 (40) eggs | log cfu/square cm | 0.91 | 0.9 | p>0.05 | farm construction, management, handling in supply chain |
| Álvarez-Fernández *et al.* (2012) | coliforms | Spain | egg shell / supermarket | 10 (10) boxes with 12 eggs, 40 (40) eggs | log cfu/square cm | 0.1 | 0.25 | p>0.05 | farm construction, management, handling in supply chain |
| Álvarez-Fernández *et al.* (2012) | *Pseudomonas* spp. | Spain | egg shell / supermarket | 10 (10) boxes with 12 eggs, 40 (40) eggs | log cfu/square cm | 1.94 | 1.49 | p>0.05 | farm construction, management, handling in supply chain |
| Álvarez-Fernández *et al.* (2012) | *Enterococcus* spp. | Spain | egg shell / supermarket | 10 (10) boxes with 12 eggs, 40 (40) eggs | log cfu/square cm | 0.13 | 0.27 | p>0.05 | farm construction, management, handling in supply chain |
| Álvarez-Fernández *et al.* (2012) | *Staphylococcus* spp. | Spain | egg shell / supermarket | 10 (10) boxes with 12 eggs, 40 (40) eggs | log cfu/square cm | 2.14 | 1.36 | p<0.05 | farm construction, management, handling in supply chain |
| Álvarez-Fernández *et al.* (2012) | Moulds and yeasts | Spain | egg shell / supermarket | 10 (10) boxes with 12 eggs, 40 (40) eggs | log cfu/square cm | 1.02 | 1.3 | p>0.05 | farm construction, management, handling in supply chain |
| De Reu *et al.* (2006) | gram-negative bacteria | ? Belgium | egg shell / farm | 2 (1) farm, 40 (40) eggs | log cfu/egg shell | 3.85 | 3.31 | p<0.001 | not mentioned |
| De Reu *et al.* (2006) | total aerobic bacteria | ? Belgium | egg shell / farm | 2 (1) farm, 40 (40) eggs | log cfu/egg shell | 5.08 | 5.46 | p<0.001 | not mentioned |
| Galiş *et al.* (2011) | total microorganisms on shell | Romania | Eggs / local market | 64 (64) eggs | cfu/g | 50.9-106 | 111.4 | not provided | org: contact with environment (laying on soil, eating insects/worms/vegetation) |
| Galiş *et al.* (2011) | total microorganisms in yolk | Romania | Eggs / local market | 64 (64) eggs | cfu/g | 7.12-15.14 | 23.83 | not provided | org: contact with environment (laying on soil, eating insects/worms/vegetation) |
| Galiş *et al.* (2011) | total microorganisms in albumen | Romania | Eggs / local market | 64 (64) eggs | cfu/g | 1.36-31.47 | 51.76 | not provided | org: contact with environment (laying on soil, eating insects/worms/vegetation) |
| Galiş *et al.* (2011) | *Salmonella* spp. | Romania | Eggs / local market | 64 (64) eggs | sample prevalence (%) | 6-19 | 20-23 | not provided | conv: stricter hygiene control compared to other systems |
| Messens *et al.* (2007) | *Salmonella enterica*, *Salmonella enteritidis* | ? Belgium | commercially available eggs / farm  | not mentioned | egg shell penetration | 0 | 0 | not traceable to housing system | older hens lower penetration, moulting, feed composition, breed |
| Schwaiger *et al.* (2008) | *Salmonella* spp. | Germany | cloacal swap / farm | 10 (10) farms, 400 (399) swaps | cloacal swab prevalence (%) | 1.8 | 3.5 | not statistically significant | not mentioned |
| Schwaiger *et al.* (2008) | *Campylobacter* spp. | Germany | cloacal swap / farm | 10 (10) farms, 400 (399) swaps | cloacal swab prevalence (%) | 29 | 34.8 | marginally higher | org analysed within 72 hours, conventional in up to 5 days, which could have led to conspicuous decrease in isolation rate |
| Schwaiger *et al.* (2008) | *Escherichia coli* spp. | Germany | cloacal swap / farm | 10 (10) farms, 400 (399) swaps | cloacal swab prevalence (%) | 69 | 64.4 | no relevant difference | not mentioned |
| Schwaiger *et al.* (2008) | *Citrobacter*, *Enterobacter*, Pantoea | Germany | cloacal swap / farm | 10 (10) farms, 400 (399) swaps | cloacal swab prevalence (%) | 0 | 0 | only single cases | not mentioned |
| Schwaiger *et al.* (2010) | *Enterococcus* spp. | Germany | cloacal swap / farm | 10 (10) farms, 400 (399) swaps | isolate cloacal swab prevalence (%) | 1.2025 | 1.10776942 | not provided | conv: forget to disinfect technical equipment as ventilators, lighting; org: bacteria killed by sun outdoor, lower stocking density slows bird-bird spread |
| Schwaiger *et al.* (2010) | *Listeria* spp. | Germany | cloacal swap / farm | 10 (10) farms, 400 (399) swaps | isolate cloacal swab prevalence (%) | 1.75 | 1.25313283 | not provided | conv: forget to disinfect technical equipment as ventilators, lighting; org: bacteria killed by sun outdoor, lower stocking density slows bird-bird spread |
| Schwaiger *et al.* (2010) | *Enterococcus* spp. | Germany | egg content / farm | 10 (10) farms, 40 (40) eggs | isolate egg content prevalence (%) | 27.5 | 20 | not provided | direct contact with dust, soil and faeces in house, cross-contamination at packaging |
| Schwaiger *et al.* (2010) | *Enterococcus* spp. | Germany | egg shell / farm | 10 (10) farms, 40 (40) eggs | isolate eggshell prevalence (%) | 60 | 60 | not provided | direct contact with dust, soil and faeces in house, cross-contamination at packaging |
| Schwaiger *et al.* (2010) | *Listeria* spp. | Germany | egg content / farm | 10 (10) farms, 40 (40) eggs | isolate egg content prevalence (%) | 2.5 | 0 | not provided | not mentioned |
| Schwaiger *et al.* (2010) | *Listeria* spp. | Germany | egg shell / farm | 10 (10) farms, 40 (40) eggs | isolate eggshell prevalence (%) | 0 | 0 | not provided | not mentioned |

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