



Federal Office of
Consumer Protection
and Food Safety



BfR
Bundesinstitut für Risikobewertung

Zoonoses Monitoring 201+

Summary of Findings and Conclusions



1 Summary of findings and conclusions

Salmonella spp.

One per cent (1.0%) of the samples of composite feed of laying hens drawn at feed manufacturing plants were contaminated with *Salmonella* spp. The findings show that *Salmonella* can be introduced in laying hen flocks through feeding them composite feed. The typing of *Salmonella* isolates in laboratory supported this conclusion, as the serovar type *Salmonella* Agona found in the composite feeds was also repeatedly detected in laying hen stocks in the course of official controls of egg-producing poultry farms. This makes clear that the processing of feedstuffs requires a high degree of diligence, because it cannot be precluded that feedstuffs are contaminated or re-contaminated with *Salmonella* in the manufacturing plant, in spite of thermal treatment.

Salmonella spp. was detected in the faeces of fattening pigs sampled at farm level in 7.9% of the samples, and in 6.1% of samples of caecal content of fattening pigs sampled at the slaughterhouse. These percentages are in the same range as the findings of previous zoonoses monitoring programmes. The rate of *Salmonella* findings in faeces of fattening pigs of category-I farms (farms with low *Salmonella* antibody status) was much lower than in category-III farms (farms with high *Salmonella* antibody status), with 5.0 versus 30%, respectively. The monitoring thus confirms that the serological categorisation of fattening farms pursuant to the German Regulations to reduce the spread of *Salmonella* through slaughter pigs (short: *SchwSalmoV*) has a correlation with the bacteriological findings in pigs at these farms. At the same time, the findings show that even pigs of category-I farms harbour a risk of *Salmonella* contamination of meat during slaughter, because there may be infected pigs at these farms, too. Comparable results were obtained before in the monitoring programmes of 2011 and 2015. In the tendency, pig carcasses were less often contaminated with *Salmonella* spp. in 2017 (2.9% positive samples) than in earlier programmes (4.0% positive samples in 2011 and 4.5% positives in 2015). The same holds for minced pork meat. While 5% and 1.3%, respectively, of the samples of minced pork meat were positive for *Salmonella* in the Zoonoses Monitoring programmes of 2009 and 2011, the findings in 2017 were only 0.7%. In spite of the relatively low contamination rate, pork is an important source of infection of humans with *Salmonella* because of quite common raw consumption, such as in the form of spiced ground pork. Samples of spreadable raw sausages did not have any *Salmonella* findings. On that basis, one cannot conclude that spreadable raw sausages are a particularly important source of human infection with *Salmonella* spp. Yet, there should be more studies in order to clarify how these results match with

the fact that there have been outbreaks of Salmonellosis which were clearly attributable to consumption of spreadable raw sausage.

Ruminant game meat seems to be of minor importance as a source of human infection with *Salmonella* spp., as only 0.8% of the samples were *Salmonella* positive. This had already shown in the 2012 Zoonoses Monitoring, when the number of findings in ruminant game meat samples was zero.

Antibiotic resistance rates in were highest in *Salmonella* isolates obtained from faecal samples taken from fattening pigs at farm level. Here, 92.9% of the isolates were resistant towards at least one antibiotic. Resistance rates measured in *Salmonella* isolates from faecal samples of fattening and young pigs in previous years' monitoring programmes were similarly high. Compared to that, *Salmonella* isolates obtained from caecal content of fattening pigs at the slaughterhouse had a lower rate (61.9% of resistant isolates). This difference is linked with the higher portion of isolates of the serovar *S. Typhimurium* and its mono-phase variant – which are characterised by high rates of resistance – in the faecal samples as compared to caecal samples. With 61.9% in the 2017 programme, the resistance rate in isolates from caecal samples was lower than in the 2015 programme, with 82.6%. This, too, is attributable to the fact that the share of *S. Typhimurium* in isolates from samples of caecal content of slaughter pigs was smaller in 2017 than in the 2015 programme. *Salmonella* isolates obtained from pig carcasses were resistant in about 75% of cases, in 2017 the same as in 2015. *Salmonella* isolates from various levels of the fattening pigs food chain showed, in some single cases, resistance towards third-generation cephalosporins, ciprofloxacin and colistin. This needs further observation, because these substances are important antibiotics in human medicine.

Salmonella isolated from game meat was mainly *S. Enteritidis* and susceptible to all substances tested.

***Campylobacter* spp.**

Campylobacter spp. was detected in 78.8% of neck skin samples taken from broilers at slaughter, which is about as frequent as in the previous year's Zoonoses Monitoring (with 76.9% positive neck skin samples). The percentage of neck skin samples with high *Campylobacter* counts of more than 1,000 cfu/g has also remained roughly the same, with 22.7%, (2013: 19.4%, 2016: 24.1%). The same holds for the contamination rate in fresh broiler meat. The *Campylobacter* spp. detection rate in samples of fresh broiler meat was 51.5% - again at about the same level as in previous years (2014: 54% positive samples, 2016: 47.2% positive samples). 9.1% of the fresh broiler meat samples contained quantifiable amounts of *Campylobacter* spp. Monitoring programmes of earlier years had already shown that meat samples have clearly lower bacterial counts than carcass samples. The highest bacterial count here was 680 cfu/g. The findings make clear that it is absolutely necessary to further improve poultry meat hygiene in order to reduce the prevalence of *Campylobacter* spp. in the poultry meat food chain. A means to this end is the introduction in 2018 of the slaughter process hygiene criterion of 1 000 cfu/g with regard to *Campylobacter* on broiler carcasses. If an establishment fails to meet this hygiene criterion, the establishment has to take certain actions in order to ensure process hygiene.

Campylobacter spp. findings in caecal content of slaughtered pigs were frequent (75.5% positive samples). This is roughly similar to findings in the 2015 Zoonoses Monitoring (73.1% positives) and confirms that pigs are a reservoir of *Campylobacter*. The pig slaughter process, though, seems to provide efficient protection against contamination of the meat, because fresh pork is hardly ever contaminated with *Campylobacter*, as previous monitoring programmes showed (0.2 to 0.5% positive samples).

Wild-living ruminants hardly ever carry *Campylobacter* spp. Only 0.8% of their faecal samples were *Campylobacter*-positive. Correspondingly, the meat was hardly ever contaminated with *Campylobacter* spp. (0.8% of samples). Fresh ruminant game meat which was examined under the 2012 Zoonoses Monitoring had a comparable contamination rate with 0.5% of positive samples. The findings so confirmed that ruminant game meat is of minor importance as a source of human infection with *Campylobacter* spp.

As in previous years' programmes, isolates of *Campylobacter coli* – the species which is predominant in pigs – displayed higher rates of resistance to antimicrobials than isolates of *Campylobacter jejuni*. The rate of resistance in *C. coli* isolates obtained from slaughtered pigs was 93.9%, that is, nearly the same as found in the 2015 programme (94.7%). It was conspicuous that more isolates (53.8%) were resistant towards ciprofloxacin in 2017 than in 2015 (42.8%). We do not know the reason for that.

Listeria monocytogenes

Tatar/Minced beef was frequently contaminated with *Listeria monocytogenes*, with 11.2% positive samples. Quantitative measurements, however, did not produce any findings exceeding the critical limit of 100 cfu/g which is stipulated for ready-to-eat foodstuffs by Regulation (EC) No. 2073/2005 on microbiological criteria for foodstuffs. The maximum finding was 35 cfu/g. Still the findings show that tartar/minced beef is a potential source of human infection with *Listeria monocytogenes*, because this tartar is usually consumed raw, and growth of *Listeria* present in the meat cannot be excluded. Susceptible consumer groups such as small children, elderly or immune-suppressed people, or pregnant women, should consume tartar/minced beef only after thorough cooking.

L. monocytogenes was also found in 12.2% of samples of spreadable raw sausages. In single samples, the *L. m.* bacterial counts were such as to mean a potential risk to human health (220 cfu/g and 550 cfu/g). So, spreadable raw sausages harbour a risk of human infection with *L. monocytogenes*. Sensitive consumer groups such as small children, elderly and immune-suppressed people should therefore refrain from consumption.

Shigatoxin/Verotoxin-forming *Escherichia coli* (STEC/VTEC)

Roe frequently carried STEC/VTEC, with 40.2% positive faecal samples. The detection rate in fresh ruminant game meat was 29.8% - nearly twice as high as in the 2012 Zoonoses Monitoring, when 16.1% of the ruminant game meat samples were found STEC/VTEC-positive. In contrast to that, the STEC/VTEC detection rate in fresh beef, which was subject to the monitoring programmes of previous years, was only about 2%, although a considerable percentage of the bovines examined were actually colonised by STEC/VTEC (roughly 20% positive faecal samples). Higher contamination rates in game meat compared to farm animal meat are probably attributable to the particular circumstances of game meat production, which bring along a higher risk of bacterial contamination, namely by digestive tract injuries through gunshots, less bleeding compared to slaughtered animals, and belated evisceration of the game carcass. This would also explain in tendency higher contamination rates in meat of hunted game (29.8%) than in meat of farmed game (18.1%), because meat of farmed game is also won under better controllable conditions and therefore exposed to a lower risk of contamination. Ruminant game meat which originated from Germany was clearly more often contaminated with STEC/VTEC (33.8% positive samples) than ruminant game meat of other origins (19.8% positive samples). In order to prevent transmission of zoonotic agents to game carcasses, and thus to the meat, there must be perfect compliance with hygienic requirements in

winning and further handling of game meat. The monitoring findings make clear that meat of wild-range ruminants harbours a STEC/VTEC infection risk for humans.

The findings of STEC/VTEC monitoring tests in meat of fattened calves/young bovines range in the same order as in previous Zoonoses Monitoring programmes. STEC/VTEC was found in 6.3% of the samples of fresh meat of calves/young bovines (2012: 5.5% positive samples). Beef of adult bovines was usually found with noticeably fewer positive samples in the framework of earlier monitoring programmes (between 1% and 2% positives). Evidence of the *eae* gene – a major STEC/VTEC virulence factor – in isolates reflects the importance of fattening calves and young bovines as a possible source of heavy STEC/VTEC infections in humans. Sensitive consumer groups such as small children, elderly and immune-deficient people should be advised not to consume raw beef and raw sausage products derived there from.

STEC/VTEC was found in 3.5% of the samples of tartar (minced beef). This makes tartar, which is usually consumed raw, a vehicle of STEC/VTEC transmission to humans.

Spreadable raw sausages are also a potential source of infection for humans, as 1.7% of the samples were found positive with STEC/VTEC.

STEC/VTEC isolates obtained from the faeces of roe and from ruminant game meat were nearly all sensitive towards the anti-microbial substances tested. The same holds for the isolates from tartar/minced beef. In contrast to that, about 60% of the STEC/VTEC isolates obtained from samples of fattening calves and young bovines were resistant towards at least one of the tested substances. This correlates with the findings of previous years' monitoring programmes and reflects the frequent use of antibiotics in these animal groups. STEC/VTEC isolates obtained from spreadable raw sausages were also in part resistant to some of the substances. But, different from the isolates from fattening calves and young bovines, the STEC/VTEC isolates from raw sausage were not resistant to the antibiotics ciprofloxacin and 3rd-generation cephalosporins which play a vital role in human medicine.

Methicillin-resistant *Staphylococcus aureus* (MRSA)

MRSA occurred frequently in fattening pigs – 38.1% of sock swabs taken in pig fattening farms were found positive with MRSA. In the 2015 Zoonoses Monitoring Programme, the MRSA detection rate ranged around the same percentage, with 41.3% positive sock swab samples from stables of young pigs. Fresh pork was examined in the 2009 and 2015 programmes and was found contaminated with MRSA in 11.7% and 13.1% of samples, respectively.

The results of analyses in fattening calves and young bovines and in fresh meat of calves and young bovines are essentially the same as the findings of previous years' programmes and confirm that

MRSA is more frequently found in fattening calves and young bovines than in adult fattening cattle. 39.7% of the nasal swabs and 11.3% of the meat samples of fattening calves/young bovines were positive for MRSA in the 2017 monitoring, while the corresponding findings in adult fattening bovines under previous programmes were around 8% positive nasal swabs and between 5% and 8% positive fresh meat samples. Tatar/minced beef had 6.9% positive samples, which is comparable with the MRSA detection rate in fresh bovine meat.

MRSA isolates sent in for resistance testing were all resistant against beta-lactam antibiotics, as it was expected. In addition, nearly all of the isolates were resistant to tetracycline, which is typical of farm animal-associated strains of MRSA. Compared to previous years' findings, resistance rates in MRSA isolates from fattening pigs and from fattening calves/young bovines were overall slightly reduced. On the other hand, there was a slight increase in the resistance rate in isolates from fattening calves/young bovines towards ciprofloxacin, which is an important antibiotic in human medicine.

Yersinia enterocolitica

Y. enterocolitica was detected in 0.3% of the samples of spreadable raw sausages. This shows that spreadable raw sausages harbour a risk of human infection with *Y. enterocolitica* and supports the recommendation that spreadable raw sausages should not be consumed by susceptible consumer groups, such as very young children, elderly and immune-deficient people, or pregnant women.

Clostridium difficile

Minced pork had 1.4% *C. difficile*-positive samples and thus is a potential vehicle of transmission of that pathogen to humans. The two isolates of *C. difficile* obtained from minced pork were toxinogenous and of ribotype 078 and 001. Ribotype 078 frequently occurs in pigs, which prompts the idea that fattening pigs are the source of contamination here. The importance of *C. difficile* strains in pigs as a source of disease in humans is currently a subject of research.

Hepatitis A virus

There was no finding of Hepatitis A virus in the deep-frozen raspberry samples tested. So, this result did not allow to conclude on any importance of deep frozen raspberries as a source of hepatitis A infection of humans. Nevertheless, in view of the fact that there have been hepatitis A infections

which were definitely attributed to deep-frozen berries, susceptible consumer groups should eat deep-frozen berries only cooked.

Norovirus

Norovirus was found in one (that is, 0.2%) of the deep-frozen raspberry samples tested. So, this result confirmed that deep-frozen raspberries may be a source of human infections with norovirus, and makes clear how important it is to maintain good hygiene practice throughout growing, harvesting, and processing berries.

Commensal *Escherichia coli*

Commensal *E. coli* was not detected by quantitative method in deep-frozen raspberries. As commensal *E. coli* are indicators of faecal contamination, zero findings are a sign that the hygienic quality of deep-frozen raspberries is in general satisfactory.

The results of anti-microbial resistance testing of *E. coli* isolates confirmed findings of previous years that resistance rates differ depending on the origin of isolates. About 50% of the *E. coli* isolates obtained from faecal samples of fattening pigs at farm level and from caecal samples of slaughtered pigs were resistant to at least one anti-microbial substance. This rate is lower than found in the 2015 Zoonoses Monitoring in *E. coli* isolates from breeding sows (54.8%), young pigs (70.4%) and slaughter pigs (61.8%), or in fattening pigs in the 2011 Zoonoses Monitoring (77%). 46.7 % of the *E. coli* isolates from caecal content of fattening calves and young bovines were found resistant to at least one anti-microbial in the 2017 Zoonoses Monitoring. This was the same rate as in the 2015 Zoonoses Monitoring (46.1%). Compared to that, the resistance rate found in isolates from fattening calves and young bovines in the 2012 monitoring was higher (54.4%). *E. coli* isolates from tartar/minced beef were 27.1% resistant to antimicrobials, and thus to a higher rate than *E. coli* isolates from fresh beef analysed under earlier programmes (11.5%). This might be owing to secondary contamination which may occur during the processing of meat to tartar/minced meat. *E. coli* isolates from roe and ruminant game meat showed fairly low resistance rates of 2% to 3%.

ESBL/AmpC-forming *Escherichia coli*

ESBL/AmpC-forming *E. coli* were detected by selective methods in about 45.6% of the faecal samples from pig fattening farms and in 47.0% of caecal samples drawn from fattened pigs at slaughter.

These findings are in the same range as in previous years' programmes, where also about half of the samples of faeces and caecum content of young and fattening pigs were positive with ESBL/AmpC-forming *E. coli*. Fresh meat of pigs showed a contamination rate with ESBL/AmpC-forming *E. coli* of 5.5%. This, too, is in line with the findings of 2015 (5.7% positive samples).

Caecal samples from fattening calves/young bovines at slaughter were again clearly more frequently found positive with ESBL/AmpC-forming *E. coli* (68.0% positive samples) than caecal samples from fattening pigs. The rate has increased compared to the 2015 zoonoses monitoring, where 60.6% of the caecal content samples were found positive with ESBL/AmpC-forming *E. coli*. The findings in fresh bovine meat corresponded to the findings in 2015 (4.4% positive samples in 2017 vs. 4.0% positives in 2015).

Roe hardly carried ESBL/AmpC-forming *E. coli*, 2.3% of the faecal samples being positive. Compared with that, the contamination rate of fresh ruminant game meat with ESBL/AmpC-forming *E. coli* was rather high, which may possibly indicate hygienic deficiencies in the production of game meat.

Deep-frozen raspberries were not found with ESBL/AmpC-forming *E. coli*, which correlates with zero findings of commensal *E. coli* in those samples.

Carbapenemase-forming *Escherichia coli*

Among the *E. coli* isolates turned in with suspected ESBL/AmpC-forming or carbapenem resistance, two were phenotypically confirmed as carbapenem-resistant *E. coli*. The isolates stemmed from faeces of fattening pigs at farm level and caecum of fattening pigs at slaughter. There were no findings of carbapenem-resistant *E. coli* in caecal content of fattening calves/young bovines or in samples of fresh pig, bovine, or ruminant game meat.

Enterococcus faecalis* and *Enterococcus faecium

73% of the *Enterococcus faecalis* and *Enterococcus faecium* isolates obtained from the fattening pigs food chain and 80% of the isolates obtained from the fattening calves/young bovines food chain were resistant to at least one of the antimicrobial substances tested. Comparable resistance rates were found in the isolates obtained from broilers and fattening turkeys in the 2016 monitoring programme. As in 2016, *E. faecalis* isolates displayed higher resistance rates towards tetracycline and chloramphenicol than *E. faecium* isolates. Resistance to ciprofloxacin, in contrast, was found only in *E. faecium* isolates. Both species displayed high rates of resistance towards erythromycin.

Round-up

The Zoonoses Monitoring serves to raise representative and comparable data on the occurrence of zoonotic agents in food-producing animals and foodstuffs of major importance, which allows drawing conclusions on the infection risk of consumers through consumption of foodstuffs. Resistance tests serve to improve the data basis in this field and contribute to better being able to analyse correlations between the use of antibiotics in animal farming and the development of resistance to antimicrobial substances. The continual testing in the framework of the Zoonoses Monitoring allows evaluating trends and developments in the spread of zoonotic agents and resistance to antimicrobials. Finally, the fact that tests are carried out at different levels of production allows recognising paths of transfer of zoonotic agents along the food chain.

The findings of analyses in the food chains related to broilers, fattening pigs, and fattening calves/young bovines, are about in the same ranges as in the years before.

As regards minced pork, the positive declining trend as regards contamination with *Salmonella* has continued – the rate of detection of *Salmonella* in minced pork samples has further decreased.

There were also fewer findings of *Salmonella* on pig carcasses, too, which is a sign of improvements in slaughter hygiene.

As regards reduction of *Campylobacter* spp. in the broilers food chain, however, progress was missing again. About a quarter of broiler neck skin samples taken at slaughter showed high bacterial counts of more than 1000 cfu/g. More testing in the framework of the monitoring programmes ahead will show whether the introduction in 2018 of the *Campylobacter* spp. process hygiene criterion (1000 cfu/g) on broiler carcasses leads to an improvement of the situation.

Programme findings show that spreadable raw sausages and tartar/minced beef are a vehicle of transmission of various zoonotic agents to humans. In particular *Listeria monocytogenes* was found frequently, and in sausages sometimes in amounts posing a potential health risk to humans. The frequency of findings should be a reason to repeat these tests in the framework of the Zoonoses Monitoring programmes at regular intervals. Apart, manufacturers of such food products should be sampled at regular intervals in the framework of official surveillance.

Programme findings also showed a high rate of contamination with STEC/VTEC in roes. The high rate of STEC/VTEC contamination in ruminant game meat – which even increased compared to the findings in 2012 – makes clear that improvements in hygiene when handling game meat are absolutely necessary, in order to prevent transmission of zoonotic pathogens to the meat.

Hepatitis-A virus and Norovirus obviously occur only seldom in detectable amounts in deep-frozen berries. But as consumption of deep-frozen berries is a proven source of human infection with these viruses, susceptible persons should consume such berries only cooked. In future monitoring programmes, it should be considered to increase sampling, in order to improve the detection rate.

MRSA was detected very frequently in fattening pigs and fattening calves/young bovines. Compared to previous years, there was no progress in reducing occurrence of these multi-resistant bacteria in the animals. Consumption of foodstuffs, however, seems to play a very minor role in transmitting MRSA to humans. Yet, consumers should take the necessary care when handling foodstuffs, with regard to this as well as other zoonotic pathogens.

Frequent detection of ESBL/AmpC-forming *E. coli* in food-delivering animals gives rise to concern because of the extra-ordinary importance of 3rd and 4th generation cephalosporins for therapy in humans. The concern is enhanced by the scientific understanding that foodstuffs can convey these resistant bacteria to humans.

Resistance rates in bacterial isolates from the fattening pig food chain found in the 2017 Zoonoses Monitoring were rather decreasing, compared to previous years, while bacteria obtained from fattening calves/young bovines showed no improvement in this respect in the same period of time.

A problem is increasing resistance observed in bacterial isolates towards ciprofloxacin, which is an important antibiotic substance in human medicine, and towards other important antibiotics.

The fact that isolates obtained from roes and ruminant game meat display lower rates of resistance reflects a weaker anti-microbial selection pressure on entero-bacteria in game.

The results of the Zoonoses Monitoring give hints on where to place focuses of official surveillance. They deliver valuable information helping government authorities to take suitable measures to reduce the prevalence of zoonotic pathogens.

Having the overriding goal to reduce consumers' exposure to zoonotic pathogens, Zoonoses Monitoring contributes significantly to health protection of consumers.

Consumers can protect themselves from food-borne infections by thoroughly cooking meat and keeping to strict hygiene rules in the kitchen, preventing transfer of pathogens from raw meat to ready-to-serve food. In order to prevent bacterial growth in meat and certain ready-to-eat foodstuffs, the cooling chain should be maintained throughout, and best-before or consumption periods should be defined as short as appropriate. Susceptible consumer groups, such as small children, elderly and immune-suppressed people, or pregnant women, should not consume raw

minced meat and other raw meat and raw milk products, nor certain ready-to-eat foodstuffs, as they harbour a potential health risk. The Federal Institute of Risk Assessment (BfR) has published information leaflets on how to minimise the risk of infections with Campylobacter, STEC/VTEC, and Listeria, as well as on how to protect from food-borne infections in the private household.