Federal Office of Consumer Protection and Food Safety

BfR

Zoonoses Monitoring 2019

Summary of Findings and Conclusions

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Salmonella spp.

Samples of pigs' single feeds drawn at compound-feed plants were found contaminated with *Salmonella* spp. at a rate of 1,9 %. This shows that *Salmonella* may be carried into fattening pig stocks by feeding of single feeds. This is backed by the results of typing of *Salmonella* isolates. The most frequent serovar in pigs, *Salmonella* Typhimurium, or its monophasic variant was also detected in the feeds. The entry of *Salmonella* in live stocks via feeds is a fundamental challenge to Salmonella control in pigs, because it may counteract other efforts to enhance biosafety in stocks. Feed batches should therefore be tightly controlled, in order to be able to sort out contaminated batches early.

Faecal samples of fattening pigs at farm level were found positive with Salmonella spp. at a rate of 5.7%, and thus less frequently than in previous years (2011: 9.4% positive samples, 2017: 7.9% positive samples). The result of testing of caecal content of fattening pigs at the slaughter house (5.8% positive samples) corresponded with the test results of previous years, where also around 6% of the samples had been positive with Salmonella. Unlike in previous years, the 2019 Zoonoses Monitoring programme did not bring out notable differences in Salmonella findings in faecal or/and caecal content of fattening pigs from farms of different categories under the German *Regulations to reduce the spread of* Salmonella *by slaughter pigs* (short title: SchwSalmoV). There were, however, only very few samples from category-II or III farms. The contamination rate of pig carcasses with *Salmonella* in the 2019 Zoonosis Monitoring was 3.4%. That were in tendency fewer findings of contamination of carcasses than in the year before, when 5.1% of the carcase samples were positive with *Salmonella*. As a whole, one cannot discern a trend with regard to *Salmonella* detection rates on pig carcasses over the past few years, but rates are rather oscillating between about 3% and 5% positive samples. Fresh porcine meat from conventional production was contaminated with Salmonella at a rate of 0.4%, which corresponded to the findings in previous years. Fresh pork from ecological production had a comparable contamination rate of 0.6%.
Minced pork was contaminated with Salmonella at a rate of 1.9%. These were some more Salmonella-contaminated samples than in previous years (2017: 0.7% positive samples, 2018: 1.3% positive samples). *Salmonella* serovars identified in the samples included such that particularly often cause infections in humans. This underlines the importance of minced pork as a potential source of infection of humans with *Salmonella*. The findings show that the entry of *Salmonella* in slaughterhouses through *Salmonella*-positive pigs has not changed in the past few years. Results of typing analyses confirm that pig carcasses are cross-contaminated with *Salmonella* from faecal content, as

Salmonella serovars identified on carcasses and in faecal and caecal content are in the majority the same. In order to prevent contamination of carcasses, and thus of the meat, it is very important to reduce the *Salmonella* load in pigs by intensive *Salmonella* control measures at farm level.

Carcasses of veal calves and young bovines were tested for Salmonella for the first time in the framework of the Zoonoses Monitoring in 2019. The contamination rate found was low, with 1.0% positive samples, and was comparable to the *Salmonella* detection rate in samples of fresh bovine meat (0.6% positive samples). The results confirm that bovine meat means a fairly low risk as regards human infection with Salmonella. Yet, serovars identified in bovine meat included *Salmonella* Typhimurium, its monophasic variant, and *Salmonella* Kentucky which frequently cause infections in humans, or display strong resistance to antimicrobials (*S*. Kentucky). This gives weight to the recommendation that vulnerable consumer groups, such as small children, elder and immune-deficient people, or pregnant women should not consume bovine raw minced meat, such as, tartar and others.

Bulk milk from dairy cow farms did not have any Salmonella findings, the same as in the 2010 programme. So, the results show that raw cow milk does not seem to play a role as a source of human infection with Salmonella.

Also, Salmonella was not found in any sample of faeces of wild ducks or wild geese, so these birds do not seem to be an important reservoir of Salmonella. On the other hand, it cannot be completely excluded that the amount of sampling material taken with a swab test is not enough to certainly detect present Salmonella.

With 1% positive findings, imported fish harvested from aquaculture is a potential source of infection of humans with Salmonella and should therefore be consumed only after thorough cooking. The serovars found in the samples play only a minor role in human infections with *Salmonella*, however.

Neither deep-frozen parsley nor fresh baby spinach had any findings of *Salmonella*. So, these results do not indicate a human infection risk with *Salmonella* emanating from these vegetal foodstuffs.

The highest rates of antimicrobial resistance were found in *Salmonella* isolates from the fattening pigs food chain towards ampicillin, tetracycline, and sulfamethoxazole (between

45% and 53% resistant isolates). Compared to the Zoonosis Monitoring in 2017, when between 70% and 85% of isolates were resistant towards these antimicrobials, rates were lower last year. The difference is connected with the larger portion of isolates of the serovar *Salmonella* Derby in total samples of the 2017 Zoonoses Monitoring. This serovar displays lower anti-microbial resistance than *Salmonella* Typhimurium. Positive aspects of findings were that there was no resistance against 3rd generation cephalosporins, and that resistance to fluoroquinolones was lower than in the 2017 monitoring (2.9% now, compared to 6.1% in 2017).
The seven Salmonella isolates obtained from veal calves/young bovines also displayed the highest rates of resistance towards the substances ampicillin, tetracycline, and sulfamethoxazole. The one isolate which was resistant against fluoroquinolones was serovar *Salmonella* Kentucky, which has typically displayed high rates of resistance for some years now. Three isolates were resistant to colistin, which is also an important anti-biotic in human medicine.

Salmonella isolates stemming from single feeds for fattening pigs were sensitive towards all substances tested. On the other hand, all Salmonella isolates obtained from imported aquacultured fish showed resistance against the fluoroquinolone ciprofloxacin.

***Campylobacter* spp**.
Faecal swab samples of wild ducks and geese had no findings of *Campylobacter* spp. It cannot be precluded, however, that the bacteria were no longer detectable in the faecal swabs because of their high sensitivity to dehydration.

In bulk milk from dairy cow farms, *Campylobacter* spp. was detected in 2.5% of the samples. This detection rate is comparable to the findings in 2014 (2.2% positive samples) and 2010 (1.9% positive samples). It is slightly increased compared to 2009, when 0.9% of bulk milk samples were found positive with *Campylobacter* spp. Consumers should definitely follow the recommendation to thoroughly heat raw milk before consumption, because raw milk harbours a potential health risk with *Campylobacter.*

Both fattening pigs and fattening calves/young bovines were frequently colonised with *Campylobacter* spp., 67.3% and 49.4% of caecal content samples being positive, respectively. The findings confirmed that pigs and bovines are a *Campylobacter* reservoir. Anyhow, the detection rate clearly decreased in both animal species compared to findings in previous monitoring programmes, when 75.5% of samples of fattening pigs

and 64.2% of samples of veal calves or young bovines were positive with *Campylobacter.* The slaughter process with pigs and bovines seems to efficaciously prevent contamination of the meat with *Campylobacter* spp., because fresh pork and beef is rarely contaminated, as zoonosis monitoring findings of earlier programmes showed (<1% *Campylobacter*-positive samples of fresh pork and beef). Fresh pork and beef therefore plays a subordinate role as a vehicle of transmission of *Campylobacter* spp. On the other hand, both minced pork and fresh beef were related with food-borne *Campylobacter* outbreaks in the past.

The detection rate of *Campylobacter* spp. in samples of fresh broiler meat was 46.4% and thus in the same range as in the previous monitoring programmes (2014: 54.0% positive samples; 2016: 47.2% positive samples; 2017: 51.8%; 2018: 47.8%). Neither did any progress show as regards reduction of high *Campylobacter* counts on broiler carcasses. Although a process hygiene criterion was introduced for *Campylobacter* spp. on broiler carcasses in 2018, the percentage of neck skin samples with high *Campylobacter* counts of more than 1000 cfu/g remained, with 23.4%, about as high as in the years before (2013: 19.4%; 2016: 24.1%; 2017: 22.7%; 2018: 22.6%). The fresh broiler meat samples had clearly lower bacterial counts than the neck skin samples. Using the quantitative method, 3.1% of samples of fresh broiler meat were found with *Campylobacter*. Only 0.7% of the samples had high counts of more than 1000 cfu/g. This may be related with the fact that the skin, which is particularly prone to contamination, does not form part of the samples of fresh broiler meat analysed in the Zoonosis Monitoring. However, the low dose of the pathogen needed to cause infection in humans means that even low *Campylobacter* counts in foodstuffs pose a risk of infection.

The findings make clear that efforts to reduce the prevalence of *Campylobacter* in the poultry meat-related food chain must continue to be intensified. Introduction of a process hygiene criterion referring to *Campylobacter* spp. on broiler carcasses was actually meant to promote that aim, by requiring food business operators to take appropriate measures to secure process hygiene when the hygiene criterion was not met
It struck again that there were wide differences among individual slaughter establishments as regards the frequency of occurrence of high *Campylobacter* counts on broiler carcasses. More studies are therefore wanted in order to show what measures are suitable to reduce the risk of massive contamination of carcasses at slaughterhouse level.
At the same time, the findings underline the need for consistent education of consumers about the risks associated with fresh poultry meat, as C*ampylobacter* spp. is going to

remain a relatively frequent finding in raw chicken meat, even if the situation improves considerably.

As it was also found in the years before, Cam*pylobacter coli* isolates – the species isolated mostly in pigs – displayed higher rates of resistance to antimicrobials than isolates of *Campylobacter jejuni*. C. coli isolates from caecal content of slaughtered pigs displayed highest resistance rates towards tetracycline and streptomycin. This corresponded with the findings of previous monitoring programmes. Resistance towards ciprofloxacin was at a rate of 55.4%, and thus roughly corresponding with the rate found in the 2017 Zoonoses Monitoring (53.8%). The resistance rate of *Campylobacter* isolates towards the substance erythromycin was 6.1%. This is some decrease compared to earlier years (2017: 12.6%; 2015: 10.7%), which is an advantage. This is important as erythromycin is an anti-biotic treatment applied against campylobacteriosis in humans. *C. coli* isolates obtained from caecal content of veal calves and young bovines at the slaughterhouse displayed higher resistance rates towards ciprofloxacin (80.4%), erythromycin (19.6%), and tetracycline (93.5%) than *C. coli* isolates from caecal content of pigs.

Listeria monocytogenes

Bulk tank milk samples from dairy farms had 3.0% positive findings of *Listeria monocytogenes*, which is roughly at a level with the rate of findings in the Zoonoses Monitoring of 2014. In 2010, the rate of findings had been somewhat higher in tendency, with 4.6% *Listeria monocytogenes*-positive bulk milk samples. As milk intended for direct human consumption is always heat-treated before being distributed to consumers in Germany, zoonotic pathogens in bulk milk do not pose a risk to consumers. But a health risk emanates from raw milk when it is not heat-treated, such as in the production of raw milk cheese or other raw milk products. Vulnerable consumer groups, namely small children, elderly or immune-suppressed people, or pregnant women, should therefore be advised to refrain from consuming raw milk products.

Imported fish grown in aquaculture was frequently contaminated with *Listeria monocytogenes*. The portion of positive samples here was 33.1%. This means basically a risk of human infection with this pathogen. When rating the risk, however, one has to consider that aquacultured fish is not a ready-to-eat food, but is cooked before consumption, as a rule. With poor kitchen hygiene, however, there is a risk that other, ready-to-eat food such as salad, may be cross-contaminated while the fish is being

prepared. *Listeria monocytogenes* may also be introduced into fish processing establishments with the raw fish. There it may re-contaminate other product that has been heat-treated before and should be ready-to-eat. It is therefore important to prevent *L. monocytogenes* from entering into fish processing establishments with raw fish.

In samples of frozen parsley, *Listeria monocytogenes* was detected at a rate of 1.3%. Bacterial counts were low, however, none of the samples being detected with more than 10 cfu/g, which is the detection limit of the quantitative method for *Listeria*. *Listeria monocytogenes* levels of this magnitude do not usually pose a health risk to humans. Sensitive consumer groups with an increased risk of contracting listeriosis, such as pregnant women and elderly people, should nevertheless refrain from consuming foods with raw frozen parsley as an ingredient, since growth *Listeria* once present in the food cannot always be definitely ruled out.

Shigatoxin-forming *Escherichia coli* (STEC)

STEC was not detected in any of the faecal swabs of wild ducks and wild geese examined, so that these animals do not appear to be a reservoir for STEC.

Bulk tank milk from dairy farms was contaminated with STEC at a rate of 4.9%. This rate was clearly higher than in 2009 and 2010, when 1.5% and 1.4% of the samples were STEC-positive. In the 2014 zoonosis monitoring, 3.6% of the tank milk samples were contaminated with STEC. The importance of raw milk as a possible source of STEC infections in humans is underlined by the fact that the isolates obtained particularly often carried the *eae* gene, which is one of the main virulence factors of STEC.
The results confirm that raw milk and raw milk products that have not been heat-treated pose a potential health risk and should therefore not be consumed by sensitive consumer groups such as small children, elderly and immunocompromised people, or pregnant women.

In veal calves and young bovines, STEC was detected at a higher rate in 2019 than in previous monitoring programmes. While 43.2% of caecal content samples taken from veal calves and young bovines at slaughterhouses were found positive with STEC last year, only about 25% caecal content samples had been STEC-positive in previous years. The detection rate of STEC in fresh beef was 4.4% and thus also a bit higher than in the zoonosis monitoring of previous years, when 1% to 2% of the beef samples were found contaminated with STEC. The results confirm that veal calves and young bovines are

often carriers of STEC, and that the meat can be contaminated with the bacterium during meat production. STEC types that are frequently at the cause of EHEC diseases in humans occurred both in isolates obtained from intestines and such from meat. Detection of the *eae* gene in some of the isolates underlines the importance of fattening calves, young bovines and bovines in general as a possible source of serious EHEC infections in humans. Vulnerable consumer groups, such as small children, elderly and immuno-compromised people, or pregnant women, should be advised not to consume raw beef and raw sausage products made from it.

STEC findings were frequent in minced pork, with 7.4% positive samples. The detection rate was significantly higher than in the 2009 zoonosis monitoring, when STEC was found only in 0.8% of the minced pork samples. The isolates obtained included *O* group which often causes EHEC infections in humans. None of the isolates carried the *eae* gene, however. The results show that minced pork principally harbours a risk of human infection with STEC.

STEC were detected in 0.3% of frozen parsley samples and in 1.2% of fresh baby spinach samples. This means that these vegetal foodstuffs are a potential source of STEC infections in humans, in particular because they are often consumed without prior heating. The importance of vegetal foodstuffs as a source of EHEC infections is underlined by the fact that isolates obtained from baby spinach included STEC serogroup O157, which is most important in the world, and which here additionally carried the eae gene. Fresh herbs and lettuce should therefore be washed thoroughly before consumption, in order to reduce possible contamination with germs.

With a rate of 67%, STEC isolates obtained from caecal content of veal calves and young bovines were most frequently resistant to at least one of the anti-microbial substances tested, which is in line with the results of previous years' monitoring programmes and reflects the frequent use of antibiotics in these animal groups. The resistance rates of the STEC isolates from tank milk, beef, and minced meat were 16.6%, 27.1%, and 37.5%, respectively. Still, in contrast to the isolates from veal calves and young bovines, the STEC isolates from tank milk, beef, and minced meat were not resistant to 3rd-generation cephalosporins, which are particularly important in human medicine. 9.1% of all isolates were resistant to the fluoroquinolone ciprofloxacin. No resistance was observed to tigecycline, meropenem or colistin. All three STEC isolates from baby spinach and frozen parsley were sensitive to the antibiotic substances tested.

Methicillin-resistant *Staphylococcus aureus* (MRSA)

MRSA was detected in 35.7% of sock swab samples taken at fattening pig farms and in 22.4% of samples from pig carcasses. The results are thus in a range similar to previous years, where 38.1% of the sock swabs and 20.2% of the pig carcasses were positive for MRSA. The findings confirm that MRSA is frequently occurring in the food chain related to fattening pigs. The results of typing of MRSA isolates in the laboratory show major correspondence of *spa* types detected in primary production and at the slaughterhouse, which indicates that the bacteria are transferred from animals to carcasses in the course of food production.

Bulk tank milk had a little lower contamination rate with MRSA (7.7% positive samples) than tank milk from conventional dairy farms in the 2014 zoonosis monitoring (9.7% positive samples). In the years 2009 and 2010, however, MRSA detection rates in tank milk were still lower and were between 4% and 5%.

Imported fish from aquaculture was frequently contaminated with MRSA, with 29.1% positive samples. Resistance patterns and *spa* types (many non-CC398 types), however, differed from livestock-associated MRSA. *Spa* types most frequently detected were such common in humans in Asia. We do not know how these bacteria get into the food chain, and whether they might be detectable already in the fish holding. However, the results indicate that previously uncommon MRSA strains can be imported into Europe via imported fish. The findings underline the recommendation that imported fish from aquaculture should only be consumed fully cooked.

The isolates sent in were all resistant to beta-lactam antibiotics, as it had been expected. In addition, almost all isolates tested stemming from fattening pigs and tank milk showed resistance to tetracycline, which is typical of livestock-associated MRSA strains. The isolates from imported aquacultured fish from, on the other hand, were only about half as often resistant to tetracycline (46.1%), but had significantly higher rates of resistance to other substances, such as ciprofloxacin and erythromycin, compared to isolates stemming from fattening pigs and tank milk. A conspicuous finding was that the isolates from the pork chain and tank milk were hardly resistant to sulfamethoxazole (1.1%), although this is an antibiotic often used in livestock and to which corresponding isolates of commensal *E. coli* were often resistant. Resistance patterns were largely identical with those of previous years.

Yersinia enterocolitica

Yersinia enterocolitica was detected in 2.7% of pork samples from conventional production and in 1.7% of pork samples from organic production. These values roughly correspond to the detection rate of *Yersinia enterocolitica* in minced pork in the 2018 zoonosis monitoring, which was 2.4%. We can assume that the *Y. enterocolitica* detected include some few non-pathogenic strains. The results confirm that pork is a possible source of human infection with pathogenic *Y. enterocolitica*. Raw pork (e.g. minced pork, or *Mett*) should therefore not be consumed by sensitive consumer groups, such as small children, elderly and immunocompromised people, or pregnant women.

Clostridioides difficile

C. difficile was not detected in any of the minced pork samples examined in the 2019 zoonosis monitoring. Under previous years' programmes, in contrast, *C. difficile* was detected in minced pork at rates of 1.4% and 0.7%, respectively. Those findings showed that minced pork is a potential vehicle of transmission of *C. difficile* to humans, all the more as part of the isolates obtained from the samples were toxigenic. The role of *C. difficile* strains from pigs as triggers of disease in humans is also currently subject of various research.

***Vibrio* spp.**

Vibrio spp. was found in 2.3% of samples of imported aquacultured fish. The isolates were the non-toxin-forming type of *Vibrio cholerae* (non-O1/non-O139), *and Vibrio metschnikovii*, a species rarely associated with human diseases. The results still confirm that fundamentally, imported aquacultured fish harbours a risk of human infection with *Vibrio* bacteria and underline the recommendation that fish should only be consumed fully cooked.

Commensal *Escherichia coli*

The results of the antibiotic resistance tests of *E. coli* isolates confirm previous years' observations that resistance rates differ depending on the origin of the isolates. Resistance rates in *E. coli* isolates stemming from the food chains related with fattening pigs and fattening calves/young bovines as well as isolates from tank milk and fresh beef were, in 2019, largely at the same level as in previous years' monitoring programmes.

About 55% of the *E. coli* isolates both from faecal samples of fattening pigs at farms and from caecal samples of slaughter pigs were resistant to at least one of the anti-microbial

substances tested. As in the years before, this rate was higher than the resistance rate in *E. coli* isolates obtained from fresh pork. Among the *E. coli* isolates from pork, 34% were resistant to at least one antibiotic substance when the pork stemmed from conventional production, and 28% were resistant when the meat stemmed from organic production. It was noticeable that, unlike with turkey meat in the 2018 zoonosis monitoring, there was no marked difference in the resistance rates of isolates obtained from meat of conventional and such of organic production. The reason for this is not known.
The percentage of resistant *E. coli* isolates was higher in isolates obtained from veal calves and young bovines (47%) than in such from tank milk (18.4%) and fresh beef (20.3%). Multiple resistance, too, occurred more frequently in *E. coli* isolates from veal calves and young bovines (29.5%) than in such stemming from tank milk (9.6%) and beef (6.8%). The only field where *E. coli* isolates from tank milk displayed higher resistance than isolates from caecal content of veal calves and young bovines and isolates from fresh beef was resistance to 3rd generation cephalosporins, which is probably related with the frequent use of these antibiotics to treat mastitis in dairy cows.

The *E. coli* isolates from imported aquacultured fish were almost exclusively resistant to (fluoro)quinolones, with resistance towards ciprofloxacin being significantly higher (58.8%) than towards nalidixic acid (20.6%). This is a conspicuous pattern of resistance and suggests that there is a common source to the bacteria.
E. coli isolates obtained from wild ducks and wild geese displayed only a low rate of resistance of 14.3%. Still, the findings show that these wild animals, too, are spreading resistant *E. coli*, though to limited extent.

ESBL/AmpC-forming *Escherichia coli*

ESBL/AmpC-forming *E. coli* were detected by selective methods in 9.8% of swabs of faeces of wild ducks and wild geese. This shows that this kind of resistance also occurs in the general environment, apart from in livestock farming.

In bulk tank milk, ESBL/AmpC-producing E. coli were detected in 10.1% of samples. The findings underline that raw milk must be thoroughly heated before consumption, as this will safely kill resistant bacteria.

ESBL/AmpC-forming *E.coli* was detected in 39.6% of faecal samples of fattening pigs at farm level and in 49.1% samples of caecal content of fattening pigs at the slaughterhouse. These findings were roughly in the same range as in previous monitoring programmes, when also near to half of the samples of faeces and caecal content of fattening pigs were found positive with ESBL/AmpC-forming *E. coli*.

Unlike what was observed in turkey meat in the 2018 Zoonosis Monitoring, there was no marked difference in the contamination rates in conventional and organic pork (meat), which had 5.7% (conventional) and 4.8% (organic pork) findings of ESBL/AmpC-forming *E. coli,* respectively. The findings in meat correspond with those of the zoonosis monitoring of the years 2015 and 2017, when 5.7% and 5.5% of the samples of (conventional) pork were detected with ESBL/AmpC-forming *E. coli*. The reasons why detection rates of ESBL/AmpC-forming E. coli in pork do not differ with the farming systems are not known.

ESBL/AmpC-producing *E. coli* were again detected significantly more often in caecum content of fattening calves/young bovines at slaughter (70.8% positive samples) than in caecum content of fattening pigs (49.1% positive samples), which might be connected with the feeding of non-marketable milk to calves – including milk from cows treated with antibiotics. The findings are roughly at level with those of the 2017 zoonosis monitoring, when 68.0% of the caecal samples of veal calves and young bovines were positive for ESBL/AmpC-forming *E. coli*, but significantly exceed the rate found in 2015 (60.6% positive samples). The results of tests of fresh beef (3.4% positive samples) roughly match the rates found in previous years (2013: 3.8% positive samples; 2015: 4.0% positive samples; 2017: 4.4% positive samples).

Imported aquacultured fish was contaminated with ESBL/AmpC-forming *E. coli* at a rate of 3.0%. This relatively low detection rate is probably owing to the fact that third-generation cephalosporins are not among the antimicrobials frequently used in aquaculture.

Carbapenemase-forming *Escherichia coli*

Among the isolates obtained from faecal samples of fattening pigs, caecal samples of fattening calves/young bovines, and fresh pork and beef, and submitted to laboratory for suspected carbapenem resistance, two isolates stemming from fattening pig stocks and one from fresh pork were confirmed as carbapenem-resistant *E. coli*. In earlier zoonosis monitoring programmes, too, carbapenemase-forming *E. coli* were only sporadically found in the pork-related food chain. The results show that these bacteria are barely spread in livestock holdings to date.

Enterococcus faecalis* and *Enterococcus faecium

The same as in previous years, resistance rates in *E. faecalis* isolates stemming from the food chains related to fattening pigs and fattening calves/young bovines were overall

higher than resistance rates in *E. faecium* isolates. The highest rates of resistance were found in isolates of *E. faecalis* to tetracycline (83.0%), erythromycin (53.2%), and chloramphenicol (31.9%). *E. faecium* isolates, on the other hand, were more often resistant to ciprofloxacin, and in some single cases also to daptomycin.
Neither species showed any resistance to vancomycin or teicoplanin, while vancomycin-resistant *E. faecium* isolates are increasingly detected in humans. The fact that resistance patterns as a whole differ between enterococcus isolates from animals and humans, indicates that both fattening calves/young bovines and fattening pigs are not a major source of human diseases with this bacterial species.

Roundup

The Zoonoses Monitoring programme raises representative and comparable data on the prevalence of zoonotic pathogens in major food-delivering animal species and major food products, in order to evaluate consumers' risk of infection through consumption of foodstuffs. Investigations into resistance improve the data situation in this field and contribute to being able to better analyse relations between the use of antimicrobials in animal farming and the development of antimicrobial resistance. Continual testing in the framework of the programme allows assessing trends and developments in the spread of zoonotic agents and antimicrobial resistance. In addition, testing at various stages of production allows tracking the paths of contamination with zoonotic pathogens along the food chain.

Results of analyses in the food chains related to broiler chickens, fattening pigs, veal calves/young bovines and dairy cattle lie in the same range as in previous years in many fields.

Ground pork samples, however, had a slightly increased Salmonella detection rate in 2019. In addition, minced pork showed a conspicuously high rate of contamination with STEC, compared to earlier investigations. The findings confirm that raw ground pork (such as "*Mett*") is not a suitable food for vulnerable consumer groups, such as small children, elderly and immune-deficient people, or pregnant women.

The results of the 2019 Zoonosis Monitoring also show that there was again no progress in reducing *Campylobacter* in the broiler chicken-related food chain. The portion of neck skin samples with high *Campylobacter* counts of more than 1000 cfu/g is 23.4%, which is

about as much as in the years before, despite introduction of the process hygiene criterion for *Campylobacter* in 2018.

Tests of bulk milk confirmed that raw milk may be contaminated with zoonotic pathogens and multi-resistant germs. Consumers should therefore consistently follow the recommendation to thoroughly heat milk bought directly at a farm.

Wild ducks and wild geese do not seem to be an important reservoir of the classical zoonotic agents. On the other hand, these birds more often harboured ESBL/AmpC-forming *E. coli*, which shows they have a share in the spread of these bacteria.

Deep-frozen parsley and baby spinach are a potential source of human infection with STEC, in particular as they are usually consumed without being cooked.

MRSA was frequently detected in fattening pigs. Compared to the years before, there has been no progress in reducing the prevalence of these multi-resistant bacteria in pigs. While food consumption hardly seems to play a role in transferring MRSA to humans, consumers should still apply the necessary care when handling foodstuffs, keeping the mind on other zoonotic pathogens, too.

Findings in fish from aquaculture show that new types of MRSA may be imported with imported foodstuffs.

ESBL/AmpC-forming *E. coli* are widely spread in fattening pigs and fattening calves/young bovines. The frequent detection of ESBL/AmpC-forming *E. coli* in farm animals is alarming with a view to the particular importance of 3rd and 4th generation cephalosporins in the treatment of human diseases – this all the more as we must assume, on the basis of current knowledge, that ESBL/AmpC-forming *E. coli* can be transferred to humans also by foodstuffs.

The results of testing of antimicrobial resistance in the 2019 zoonosis monitoring show that there have been no improvements as regards the prevalence of resistance in bacterial isolates obtained from the fattening pigs and the fattening calves/young bovine food chains, or from bulk milk and fresh bovine meat. It was striking that there were no clear differences in resistance rates in isolates from conventional and from ecologically produced pork. Further testing should be carried out at livestock level in order to raise comparative data from conventional and ecological pig fattening farms.

The findings show that it is necessary to further intensify efforts to reduce the use of antibiotics by improving animal health, in order to achieve a decline in resistance rates. The focus should lie on minimising the use of critical antibiotics, in particular such classified by WHO as HPCIA substances. The very high rate of resistance towards the cephalosporin substance class underlines the urgent need for reducing the use of cephalosporins, in particular in dairy cows. The same, we must further reduce application of colistin, because of the prevalence of the transmissible colistin resistance genes identified, and because of that substance's growing importance in human medicine.

High rates of resistance in *E. coli* isolates from imported fish towards fluoroquinolones is also a problem, because these are antibiotics of extraordinary importance in the treatment of humans. In order to avoid taking up resistant *E. coli*, imported fish should always be thoroughly cooked for consumption.
The low rates of antimicrobial resistance in isolates from wild ducks and wild geese actually reflect the low antimicrobial selection pressure to which wild-ranging animals' intestinal bacteria are exposed.

The results of the Zoonosis Monitoring programme indicate where official food surveillance has to place its foci. They provide important information helping government authorities to take suitable measures to reduce the prevalence of zoonotic pathogens.

Having the overriding objective to reduce consumers' exposure to zoonotic pathogens, the Zoonosis Monitoring programme significantly contributes to health protection of consumers.
Consumers can protect themselves from food-borne infections by thoroughly cooking meat and strictly observing a kitchen hygiene regiment that prevents transmission of pathogens from raw meat to ready-to-eat food (such as salad) during preparation of the food. In order to counteract bacterial growth in meat and certain ready-to-eat foodstuffs, cold chains should be carefully maintained and appropriate, short best-before or use-by dates should be fixed. Vulnerable consumer groups, namely small children, elderly and immune-deficient people, and pregnant women, should refrain from consuming raw minced meat and other raw meat and raw milk products, as well as certain ready-to-eat foods, as these foods harbour a potential health risk. The Federal Institute for Risk Assessment (BfR) has published information leaflets on how to minimise the risk of infections with Campylobacter, STEC, and Listeria, as well as on how to protect from food-borne infections in the private household (https://www.bfr.bund.de/de/start.html).