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Zoonoses Monitoring 2021

Summary of Findings and Conclusions

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Salmonella spp.

Salmonella spp. was found in 0.7% samples of processed oil seeds (extraction meals and expeller cakes) sampled at the time of delivery by truck to mixed feed manufacturing plants. The findings show that feeding extraction meals and expeller cakes to food-delivering animals opens a path of *Salmonella* entry into animal livestocks and thus, the food chain. Fundamentally, the entry of Salmonella in livestocks through feeds is a challenge to Salmonella control in farm animals, because it may undermine other efforts to enhance biosafety in animal stocks. Feeds should therefore be tightly controlled, in order to early identify and remove Salmonella-positive batches.

Caecal content of fattening pigs sampled at slaughter establishments was detected positive with *Salmonella* spp. at a rate of 8.4%, which is a higher rate than in previous years (2019: 5.8% positive samples, 2017: 6.1%, 2015: 6.1%). This difference was not statistically significant, though. Like in the Zoonosis Monitoring of 2019, there were no clear differences in Salmonella detection rates in caecal samples of fattening pigs stemming from different farm categories under Germany's *Regulation on the control of Salmonella in pigs* (German short title: *Schweine-Salmonellen-Verordnung*). But there were again only few samples from pigs of category-ii or category-iii farms in 2021, the same as it was in 2019. The contamination rate of pig carcasses with *Salmonella* spp. was 3.2% in the 2021 Zoonosis Monitoring, which is roughly at a level with 2019 (3.4% positive samples). The serovars most frequently found in caecal content and on carcasses of fattening pigs were *S*. Typhimurium, its monophasic variant, and *S*. Derby. There were also some single findings of *S*. Infantis, which is among the species most frequently reported with cases of *Salmonella* disease in humans, after *S*. Typhimurium and *S*. Enteritidis. As a whole, we cannot discern a trend in Salmonella detection rates in pig carcasses over the past few years, but rather rates fluctuating between 3% and 5% positive samples.

Fresh pork meat sampled at retail level was contaminated with *Salmonella* at a rate of 0.4%, which corresponds to the levels found in earlier monitoring programmes. Minced pork, too, had a similar contamination rate with *Salmonella* as in previous years, with 1.3% positive samples in 2021 (2020: 0.7% positive samples, 2019: 1.9%, 2018: 1.3%, 2017: 0.7 %). Some samples were detected with monophasic *S*. Thyphimurium, which underlines the importance of minced pork as a possible source of human infection with *Salmonella*. Seven samples of fresh pork drawn at border inspection points had no *Salmonella* findings. But the small number of samples does not allow making general statements as to the

occurrence of Salmonella in imported fresh meat. Findings show that the amount of *Salmonella* carried into slaughter establishments with *Salmonella*-positive pigs has not decreased in the past few years. The results of typing analyses have confirmed that Salmonella present in the intestines is being carried over to carcasses during slaughter, as *Salmonella* serovars detected on carcasses and in caecal contents are largely identical. In order to further reduce the contamination of carcasses, and thus of fresh meat, it is necessary – apart from observing good slaughter hygiene – to reduce Salmonella prevalence in pigs by intensive control measures at animal holdings, and as a result, reduce the entry of *Salmonella* in slaughter establishments with *Salmonella*-positive pigs. The results of the Zoonosis Monitoring show that this aim has not yet been achieved, and that further efforts are necessary in this field. Although the rate of contamination is relatively low, pork is an important source of human infection with Salmonella, because of partly customary raw consumption, namely in the form of *Mett*. Raw minced pork is therefore not a suitable food for sensitive consumer groups, such as small children, elderly and immune-deficient people, or pregnant women.

The detection rate of *Salmonella* in caecal contents of veal calves and young bovines was measured for the first time in the 2021 Zoonosis Monitoring and was defined 2.1%. The serovars found were *S*. Dublin and *S*. Typhimurium and are typically present in bovines. Neither fresh bovine meat sampled at Border Inspection Points nor such sampled at retail level was detected with *Salmonella*. This is in line with examination results of previous years' programmes, where *Salmonella* were either not found or found only at very low rates (0.4% to 0.6%) in fresh bovine meat. It confirms that bovine meat poses only a low risk of infection of humans with *Salmonella*. At the same time, previous years' programmes produced findings of the serovars *Salmonella* Thyphimurium, its monophasic variant, and *Salmonella* Kentucky, which are all either frequent pathogens in humans or displaying high rates of resistance to anti-microbials (*S*. Kentucky). The rate of detection of *Salmonella* in minced bovine meat was 0.2%, which was similar to the rate measured in the Zoonosis Monitoring of 2011. The fact that *Salmonella* was detected in minced meat supports the recommendation that mined bovine meat, including tartar, should not be consumed by vulnerable consumer groups, namely small children, elderly and immune-deficient people, and pregnant women.

Samples of lamb's lettuce, rocket salad, and ready-packed pick leaf lettuces did not have any *Salmonella* findings, which shows that these lettuces seem to play a minor role as potential sources of human infection with *Salmonella* in Germany. Still, consumers should thoroughly wash any lettuce before consumption in order to reduce the risk of

contamination with germs, given the fact that lettuce is eaten raw, without prior reduction of germs by cooking. In addition, it cannot be totally excluded that the amount of sample material subject to examination was too small to safely detect any *Salmonella* that might have been present. The fact that there were some single *Salmonella* findings in cut and ready-packed leaf lettuces in the Zoonosis Monitoring in 2015 (0.3% positive samples) means that one has to basically reckon with the presence of *Salmonella* in ready-packed lettuces and therefore backs the above recommendation.

Resistance towards at least one antibiotic test substance was found in 70.9% of *Salmonella* isolates originating from the food chain related with fattening pigs. Resistance rates were highest again towards ampicillin, tetracycline and sulfamethoxazole (54% to 65% resistant isolates). Compared with the 2019 Zoonosis Monitoring, where 45% to 53% of the isolates were resistant towards these substances, resistance rates were higher in 2021. The difference is connected with the fact that the serovar *Salmonella* Derby – which typically displays lower resistance rates than *Salmonella* Thyphimurium – made up a larger portion of *Salmonella* isolates in 2019 than in 2021. It is beneficial that there was no resistance to 3rd generation cephalosporin substances or the carbapenem substance meropenem. On the other hand, resistance towards fluoroquinolones, which are also very important for medical treatment of humans, was higher in 2021 than in 2019 (6.1% vs. 2.9%). One isolate turned out resistant to the anti-biotic colistin, which is also very important in human medicine. All six *Salmonella* isolates obtained from veal calves or young bovines were resistant towards at least one of the anti-biotic substances tested. Again, the highest rates of resistance occurred towards ampicillin, tetracycline and sulfamethoxazole.

***Campylobacter* spp**.

Samples of caecal contents of fattening pigs drawn at slaughter were found positive with *Campylobacter* spp. at a rate of 71.7%. That is, the rate of detected ranged in the same order as in previous years (2019: 67.3%, 2017: 75.5%, 2015: 73.1%). The detection rate of *Campylobacter* spp. in caecal contents of veal calves and young bovines sampled at the slaughter house was 65.6% and thus clearly higher than in the Zoonosis Monitoring of 2019 (49.4%), but at the same level as in 2015 (64.2%). While fattening pigs were nearly exclusively detected with *Campylobacter coli*, caecal contents of veal calves and young bovines were in the majority found with *Campylobacter jejuni*. The findings confirm that both fattening pigs and veal calves and young bovines represent a reservoir of *Campylobacter*, but the process of slaughter of these animals seems to efficiently prevent the contamination of meat, which is different to the situation in poultry. The results of the

Zoonosis Monitoring programmes of earlier years have shown that fresh pork and beef is very rarely contaminated with *Campylobacter* (0.0% to 0.5% positive samples). Yet, in spite of the low contamination rates, both beef and minced pork have been linked with food-borne *Campylobacter* disease outbreaks.

The detection rate of *Campylobacter* in samples of fresh chicken meat was 46.9%, that is lower than in the Zoonosis Monitoring of 2020 (54.7%), and at a level with findings in the years before (2019: 46.4% positive samples, 2018: 47.8%). Quantitative measurements of *Campylobacter* in broiler neck skin samples taken at the slaughterhouse show again that there has been no progress in reducing high *Campylobacter* counts on carcasses. With 21.6%, the portion of neck skin samples with high *Campylobacter* counts of more than 1,000 cfu/g remained roughly as high as in the years before (2020: 21.9%, 2019: 23.4%, 2018: 22.6%, 2017: 22.7%, 2016: 24.1%, 2013: 19.4%), in spite of the introduction in 2018 of a slaughter process hygiene criterion for *Campylobacter* on chicken carcasses. Fresh broiler meat samples had again much lower bacterial counts than the neck skin samples. *Campylobacter* counts higher than the detection limit of 10 cfu/g were measured in only 2.8% fresh broiler meat samples and thus much more seldom than in neck skin samples of carcasses, where the *Campylobacter* could be detected by quantitative method in 46.7% of samples. None of the broiler meat samples had a high bacterial count of more than 1,000 cfu/g. This is possibly owing to the fact that skin, which is contaminated in particular, is not part of the broiler meat samples examined in the framework of the Zoonosis Monitoring. Still, even low *Campylobacter* spp. counts in foodstuffs represent a risk of infection because of the pathogen's low infective dose in humans. In particular, cross-contamination among meat and ready-to-eat foodstuffs, such as salad, during preparation of meals plays a role in infections of consumers with *Campylobacter* spp. Altogether, the findings show that efforts to reduce the presence of *Campylobacter* in the poultry meat food chain must be further intensified. At the same time, the findings underline the need for consistent education of consumers regarding the risks associated with fresh poultry meat, as *Campylobacter* on raw chicken meat will continue to be a relatively frequent finding, even in a considerably improved situation.

Isolates of *Campylobacter coli* – which is the majority species detected in fattening pigs – again displayed higher rates of resistance to antibiotics than isolates of *Campylobacter jejuni*. Apart from that, *Campylobacter* isolates stemming from veal calves and young bovines displayed higher resistance rates than *Campylobacter* isolates stemming from pigs (95.1% resistant *C. coli* isolates in veal calves/young bovines, 84.1% resistant *C. coli* isolates in fattening pigs). The three *C. jejuni* isolates obtained from pigs were all sensitive

to antibiotics. The highest rates of resistance were found against tetracycline, both in veal calves and young bovines (92.7% resistant *C. coli* isolates), and in fattening pigs (71.7% resistant *C. coli* isolates). Rates of resistance towards erythromycin have risen compared to the Zoonosis Monitoring of 2019, amounting to 24.4% in *C. coli* isolates stemming from veal calves and young bovines, and 10.5% *in C. coli* isolates stemming from fattening pigs. This is important in so far as erythromycin is an antibiotic used to treat campylobacteriosis in humans. *C. jejuni* isolates were not resistant to this antibiotic substance. With regard to ciprofloxacin, resistance rates were largely unchanged from 2019 in *Campylobacter* isolates from veal calves and young bovines, amounting to 65.4% in *C. jejuni* and 73.2% *in C. coli*. *C. coli* isolates stemming from fattening pigs had a little higher resistance rate towards ciprofloxacin of 57.8%, compared to the Zoonosis Monitoring of 2019 (with 55.0% resistant *C. coli* isolates). As regards ertapenem – a carbapenem newly included in the range of substances to be examined – 29.1% of the *C. coli* isolates obtained from veal calves/young bovines displayed resistance.

Listeria monocytogenes

Listeria monocytogenes was detected in 12.2% of minced pork samples. Minced beef was nearly twice as often contaminated with *L. m.*, with a rate of 21.5% positive samples. Bacterial counts found using a quantifying method were nearly all very low, with a maximum 10 cfu/g, and do not usually pose a health risk to humans at this level. One sample of minced beef, however, reached the critical level of 100 cfu/g, which is defined as critical in ready-to-eat foods by Regulation (EC) No 2073/2005 *on microbiological criteria for foodstuffs*. Particularly sensitive consumer groups such as pregnant women, immune-deficient people or elderly people may also face a health risk with lower germ counts, which is why these groups should refrain from eating raw minced meat. It can also not be excluded that *Listeria* present in the meat are growing during storage, possibly resulting in bacterial counts higher than 100 cfu/g that represent a potential health risk to humans. Good kitchen hygiene should be observed in order to prevent transfer of present *Listeria* from minced meat to other foodstuffs.

Further, *Listeria monocytogenes* was detected in 2.3% of lamb's lettuce, rocket salad, and other pick leaf lettuces. Though the actual level of contamination was low – with none of the samples found with bacteria exceeding the quantitative method's detection level of 10 cfu/g – the wet environment present in foil-bagged salads promotes the multiplication of present bacteria. The findings mean that we have to basically reckon with the presence of *L. monocytogenes* in ready-packed lamb's lettuce, rocket salad, and other pick leaf lettuces, and back the recommendation that lettuce should be thoroughly washed before

consumption in order to reduce bacterial contamination. As *Listeria* might tightly stick to the leaves, one cannot assume that washing completely removes the pathogen. Sensitive consumer groups with an enhanced listeriosis disease risk, such as pregnant women or elderly people, should therefore refrain from consuming salads stored in ready packs. The test results underline the importance of observing high hygienic standards during the production, processing, storage and sale of lettuce and salads, in order to place microbiologically flawless product on the market. This is particularly important because salads are eaten raw, without a prior process to kill pathogens before consumption.

The isolates of *Listeria monocytogenes* obtained from the samples of minced pork and beef and ready-packed salads subject to examination each were in the majority of the same molecular serotypes (IIa and IVb, respectively).

Shiga toxin-forming *Escherichia coli* (STEC)

The detection rate of STEC in fresh beef samples taken at retail level was 2.1%, which was a little lower than in the Zoonosis Monitoring of 2019 (4.4% positive samples) and about the same level as in the years before (2015: 0.9% positive samples, 2013: 2.0%, 2011: 1.8%). The detection rate in fresh beef sampled at border inspection points was at about the same level, with 2.3%. Minced beef in contrast, was detected clearly more often with STEC, with 6.7% positive samples. Minced beef and *tartar/*ground beef were subject to examination for STEC before in the Zoonosis Monitoring programmes of 2011 and 2017 and were at that times found contaminated at somewhat lower rates than minced beef in 2021, namely at 3.8% and 3.5%, respectively. The isolates obtained included such STEC types which are frequently causing disease in humans (*O*26, *O*8 und *O*91) and have also been detected in cases of haemolytic-uraemic syndrome. The fact that *eae* gene, which is one of STEC's main virulence factors, was detected in one of the isolates obtained from minced beef emphasises the recommendation that sensitive consumer groups such as small children, elderly people, or pregnant women should not eat raw minced meat.

STEC was found in 1.9% of samples of ready-packed lamb's lettuce, rocket salad, and small leaf lettuces. Isolates included the O8 sero-group which is a frequent cause of EHEC infections and haemolytic-uraemic syndrome in humans. This isolate did not have the eae gene, though. The finding is important as salads are eaten raw, so that present pathogens are directly consumed. The test results confirm that ready packed lettuces are a possible source of STEC infections of humans. These lettuces should be thoroughly washed before

consumption in order to reduce possible contamination with germs. Apart from that, vulnerable consumer groups with weaker immune capacity should not consume ready packed lettuce. Different from this year, the Zoonosis Monitoring in 2015 did not produce any STEC findings in cut, ready packed leaf lettuces. However, the fact that STEC is not detected in a food does no guarantee that this food cannot be a source of human infection with STEC.

The STEC isolates showed only low levels of resistance to antibiotics, even with isolates stemming from imported meat and from lettuce samples being sensitive to all test substances. Only one isolate obtained from fresh beef was resistant to the fluoroquinolone substance ciprofloxacin. There was no resistance throughout against carbapenemen and colistin – 3rd-generation cephalosporins which are also very important in human medicine.

Methicillin-resistant *Staphylococcus aureus* (MRSA)

Seven samples of fresh pork were drawn at veterinary border inspection points for tests for MRSA, and one was found positive. The MRSA isolated from that sample was not of the farm animal-associated clonal complex CC398.

MRSA was detected at a rate of 3.5% in fresh beef sampled at retail level, which is a rate bit lower than in previous years' programmes, when 5.5% and 8.1% of the bovine meat samples were positive with MRSA. The rate of findings was higher in the 73 samples of bovine meat taken at border inspection points, where 11.0% were positive. It is to be noted that none of the MRSA isolated from the bovine meat samples taken at border control points was of the farm animal-associated clonal complex CC398, while two thirds of isolates stemming from beef sampled at retail were farm-animal associated MRSA. The strains isolated from imported beef were *spa* types frequently occurring in human medicine. Some *spa* types have so far been only detected in people and food products stemming from various third countries, so that the findings indicate that MRSA strains that have so far not been inherent may be introduced in Europe with imported beef.

Food consumption seems to play a minor role in transmitting MRSA to humans. Still, consumers should always place the necessary care in the handling of foodstuffs, also with regard to other zoonotic pathogens, because basically, there is always the possibility that the pathogen is introduced in, and then cross-contaminating, consumers' households. This is particularly important with regards to the human-associated MRSA strains detected in imported beef.

The isolates obtained were all resistant to beta-lactam antibiotics, as it had been expected. Apart from that, nearly all isolates obtained from beef and belonging to the CC398 clonal complex displayed resistance to tetracycline, which is typical of farm animal-associated MRSA strains. Those isolates from beef samples which were not of the CC398 clonal complex, in contrast, were notably less resistant towards tetracycline. The high rate of resistance in CC398 isolates from beef towards ciprofloxacin was striking, because farm animal-associated MRSA strains are usually sensitive towards this active substance. It is seen as advantageous that no isolate was resistant towards the antibiotics vancomycin and linezolid, which are particularly important in the therapy of humans with MRSA.

Yersinia enterocolitica

Yersinia enterocolitica was found in 4.7% of pig cheek meat samples taken at slaughter, which is a bit more than what was found in the previous Zoonosis Monitoring programmes in fresh pork (1.7% to 2.7% positive samples) and in minced pork (2.4% positive samples). This shows that cheek meat may be a source of entry of *Yersinia enterocolitica* into the further meat processing chain and confirms that pork may be a source of human infection with *Yersinia enterocolitica.* The isolates obtained were in the majority serotype O:3 which often causes infections in humans. In addition, all isolates carried the *ail* virulence gene, and most isolates also the *vir*F gene, which are both important factors of pathogenicity. The findings underline the recommendation that raw pork (*e.g.*, *Mett*), should not be consumed by sensitive consumer groups, namely small children, elderly or immune-deficient people, or pregnant women.

Clostridioides difficile

C. difficile was found in 2.8% of neck skin samples taken of broiler carcasses. So the findings lie in about the same range as in the Zoonosis Monitoring of 2020, where 1.6% of the broiler carcasses were found positive with *C. difficile*. Nearly all isolates were toxinogenic strains, some of which could be classified as PCR ribotype 001, which has so far more frequently been detected in humans with rather heavy disease courses. The findings show that broilers and broiler meat must be considered as a potential source of *C. difficile* infections in humans.

Presumptive *Bacillus cereus*

Presumptive *B. cereus* was detected by a quantifying method in 46.7% of samples of plastic-packed lettuce, rocket salad, and other small leaf lettuces with bacterial counts lower than 1,000 cfu/g in 26.2% of the samples. 16.1% samples had bacterial counts

between 10^3 cfu/g and 10^4 cfu/g, and 2.3% samples had counts higher than 10^4 cfu/g, up to 10^5 cfu/g. 2.1% showed bacterial counts higher than 10^5 cfu/g, that is, counts with a potential health risk. Lower bacterial counts may still pose a health risk under certain conditions. Apart from that, it cannot be precluded that present spores germinate and continue to grow in insufficiently refrigerated food or in dishes which are kept warm over a time. The highest count of presumptive *B. cereus* was $8.1x10^5$ cfu/g measured in one ready-packed lettuce sample. Part of the *B. cereus* isolates obtained were of the species *Bacillus thuringiensis*, which has the potential to produce enterotoxins and is therefore suspected of being able to cause diarrhoea diseases in humans. Because of the high degree of genetic relationship with *B. thuringiensis* strains used as active substances in EU-authorised bio-insecticides, one can assume that the presence of these strains is probably owing to the application of such insecticides in lettuce crops. The examination results show that plastic-packed lamb's lettuce, rocket salad, or other small leaf lettuces pose a risk of infection of humans with *B. cereus*. Sensitive consumer groups with lessened immune power should therefore, as a precaution, not consume lettuce from ready-packs. This recommendation is important because contamination with presumptive *B. cereus* can hardly be reduced even by washing lettuce thoroughly with drinking water.

ESBL/AmpC-forming *Escherichia coli*

ESBL/AmpC-forming *E. coli* was detected by quantitative methods at a rate of 25.6% in pooled samples of faeces of calves intended for fattening which had been raised in milk cow dairies. This rate is very clearly lower than the rate found in pooled faeces samples of fattening calves raised in farms specialised on raising fattening calves (58.9% samples positive with ESBL/AmpC-forming *E. coli*) or fattening bovines in general (45.7% positive samples). This condition is probably owing to the fact that calves which are raised in cow dairies – different from calves raised in specialised fattening farms – remain at their farm of birth, and are therefore less subject to contamination and stress by transport and assembly with calves of other origins. So, this may be linked with less antibiotic treatment and less formation of resistance. In all three farm categories, detection rates of ESBL/AmpC-forming *E. coli* were higher in younger calves than in older calves. The detection rate of ESBL/AmpC-forming *E. coli* in faecal samples of calves aged 2 to 3 months and intended for fattening, and kept at calf-fattening farms, was 63.3%. It was 57.0% in samples stemming from calves kept in general bovine fattening farms, and 31.2% in samples stemming from calves kept at cow dairies. Regarding fattening calves aged between 4 and 8 months, 55.1% of faecal samples stemming from calves at veal calf farm, 39.1% samples from calves of overall bovine fattening arms, and 19.6% of samples from calves kept at cow dairy farms were positive with ESBL/AmpC-forming *E. coli*. So, calves

raised at specialised veal calf farms always had the highest detection rates of ESBL/AmpC-forming *E. coli*.

The detection rate of ESBL/AmpC-forming *E. coli* in samples of caecal contents taken of veal calves/young bovines at slaughter was 65.6% and thus at about the same level as in the years before (70.8% positive samples in the Zoonosis Monitoring of 2019, 68.0% positive samples in 2017). The samples of fresh bovine meat taken at border inspection points did not produce any findings of ESBL/AmpC-forming *E. coli*, while fresh beef sampled at retail level had 2.4% findings, which was a bit less than found in fresh beef in the zoonosis monitoring programmes of previous years (2017: 4.4% positive samples, 2015: 4.0% positive samples). Compared with findings in fresh beef, minced beef was obviously more often contaminated with ESBL/AmpC-forming *E. coli*, with 9.9% positive samples. This gives rise to concern with a view to the possible spreading of this kind of resistance through consumption of raw minced meat.

Samples of caecal contents of fattened pigs taken at slaughter had 44.0% findings of ESBL/AmpC-forming *E. coli*, which is roughly at a level with findings in earlier zoonosis monitoring programmes, where also nearly half of caecal samples were positive with these bacteria (2019: 49.1% positive samples, 2017: 47.0%, 2015: 46.3%). Fresh pig meat sampled at retail level had 5.2% findings of ESBL/AmpC-forming *E. coli*. This is roughly the same as in earlier monitoring programmes, when 5.5% and 5.7% of fresh pork samples were found contaminated with ESBL/AmpC-forming *E. coli*.

At the present state of knowledge, we have to assume that ESBL/AmpC-forming *E. coli* can be transmitted to humans by foodstuffs, while we cannot really estimate the actual risk of infection. Bacteria present in meat will be killed by sufficient heating during preparation of the food. But in adequate kitchen hygiene is a particular risk, as bacteria may be carried across from raw meat to foodstuffs which are eaten raw (for instance, by using the same chopping board for cutting meat and later vegetables intended for raw consumption). Strict kitchen hygiene, however, can minimise the risk of infection or bacterial colonisation.

Carbapenemase-forming *Escherichia coli*

Four isolates with suspected resistance to carbapenem were sent to laboratory for examination: two obtained from fresh pork sampled at retail, and one each from fresh beef sampled at retail and from caecal contents of fattening pigs sampled at slaughter. None was confirmed as carbapenem-resistant *E. coli*. In the years before, carbapenemase-forming *E. coli* was only detected in some single cases in the food chain related with fattening pigs. The test results show that these bacteria are not widely spread in animal farms so far.

Commensal *Escherichia coli*

The portion of resistant *E. coli* isolates was nearly the same in the veal calf/young bovine food chain (43.4%) as in the fattening pig food chain (45.0%). *E. coli* isolates from both food chains displayed the highest rates of resistance towards the antibiotic substances tetracycline (34.6%), ampicillin (28.7%), and sulfamethoxazole (28.1%), which is probably owing to frequent use of these antibiotics in these farm animals. The findings about ESBL/AmpC-forming *E. coli* in veal calves at primary farms are also reflected in the resistance rates measured in *E. coli* isolates stemming from faecal samples of these animals – the percentage of resistant *E. coli* isolates was lowest in isolates stemming from calves raised in dairy cow farms (22.2%), and highest in isolates stemming from veal calves raised in specialised calf fattening farms (58.2%). *E. coli* isolates stemming from calves raised at bovine fattening farms had a 54.4% portion of resistant isolates. Overall, *E. coli* isolates obtained from caecal contents of veal calves and young bovines at slaughter displayed a somewhat lower resistance rate (47.3%) than isolates obtained from veal calves at primary farm level. This may be related with the fact that certain waiting periods have to be observed before slaughter, so that the last treatment with antibiotics dates back longer than while the animals are still kept at the farm. *E. coli* isolated from minced beef was found with a clearly lower rate of resistance (17.0%) than the isolates obtained from calves.

Resistance rates of *E. coli* isolates obtained from the food chain related with fattening pigs were, in the Zoonosis Monitoring of 2021, largely at the same level as in the years before. 29.2% of the isolates obtained from pig meat were resistant to at least one antibiotic substance. So like in the years before, the resistance level here was clearly lower than in *E. coli* isolates stemming from caecal contents of fattening pigs, of which 51.1% were resistant to at least one of the antibiotics tested. This finding is good as regards consumers' potential exposure to resistant bacteria through pork. On the other hand, resistance towards 3rd generation cephalosporins and fluoroquinolones (ciprofloxacin) was higher in *E. coli* isolates obtained from pig meat than in *E. coli* isolates from caecal contents (1.3% vs. 0% resistance to 3rd generation cephalosporins and 5.9% vs. 1.6% resistance to ciprofloxacin). We do not know the reasons for that.

E. coli isolates obtained from samples of lamb's lettuce, rocket salad, and other pick lettuces displayed no kinds of resistance.

Enterococcus faecalis* and *Enterococcus faecium

Like in the years before, isolates of *Enterococcus faecalis* stemming from the food chains related to the fattening pigs and to fattening caves/young bovines displayed overall higher resistance rates than isolates of *Enterococcus faecium*. The highest resistance rates found were those measured in *Enterococcus faecalis* isolates towards tetracycline (about. 75%) and erythromycin (35% to 39%). There were no big differences between the fattening pig and the veal calf/young bovine food chains in this respect. Resistance of *Enterococcus faecalis* isolates to chloramphenicol – an antibiotic use of which was ceased decades ago – was found more often in isolates stemming from fattening pigs (30.8%) than in such from veal calves/young bovines (15.9%). The reason for this is not known.

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, allowing an evaluation of 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 correlations between the use of antimicrobials in animal farming and the development of antimicrobial resistance. The continuity of the programme allows assessing trends and developments in the spread of zoonotic agents and antimicrobial resistance. In addition, the testing at various stages of production allows tracking recognising the paths of contamination with zoonotic pathogens along the food chain.

In many fields, the results of examinations in the food chains related with broilers, fattening pigs and veal calves/young bovines ranged in the same orders of magnitude as in the Zoonosis Monitoring programmes in the years before.

Salmonella spp., however, was detected more frequently than in the years before in caecal contents of fattening pigs sampled at slaughter. So findings show that *Salmonella* entry in slaughter establishments with colonised pigs has not become less over the past years and further efforts should be made to reduce the prevalence of *Salmonella* in pigs.

Striking findings were the high degree of contamination of minced pork and, in particular, minced beef with *Listeria monocytogenes* and the high detection rates of STEC in minced beef. The findings confirm the fact that raw minced meat is not a suitable food for sensitive consumer groups such as young children, elderly and immune-deficient people, or pregnant women.

Isolates obtained of *Listeria monocytogenes* each time were in the majority of the same molecular serotypes. This makes clear how important genomic sequencing is in case of disease outbreaks caused by *Listeria monocytogenes,* for the purpose of clarifying relationships between isolates in order to localise the foodstuff which has likely caused the outbreak.

ESBL/AmpC-forming *E. coli* are even more widely spread in veal calves and young bovines than in fattening pigs, which might be related with the fact that calves are fed milk which is not marketable otherwise. Calves are actually very rarely treated with cephalosporins. Unmarketable milk includes milk of the farm's own dairy cows treated with antibiotics, and cows' milk produced within five days after delivery of a calf. Such milk may contain residues of penicillins and cephalosporins as these are often components of drugs used to treat mastitis. The findings make clear that use of cephalosporins must be urgently curbed in dairy cows in particular.

The obvious differences in the prevalence of ESBL/AmpC-forming *E. coli* in veal calves depending on the holding system could be used as a basis for changes towards raising calves in such environments where less resistant bacteria develop, in order to contain the spread of antimicrobial resistance in this area.

The frequent detection of ESBL/AmpC-forming *E. coli* in farm animals is alarming in view of the particular importance of 3rd and 4th generation cephalosporins in the medical therapy of humans. This all the more as we have to assume, at the present state of scientific knowledge, that these resistant bacteria may also be transmitted to humans by foodstuffs.

Against this background, the high detection rate of ESBL/AmpC-forming *E. coli* in minced beef is particularly alarming, as consumption of raw minced meat can lead to a spreading of this type of resistance.

Testing of bovine meat at border control points has shown that new types of MRSA may be imported together with imported foodstuffs. The test results support the recommendation that the spread of MRSA should continue to be monitored and bacteria be characterised under the Zoonosis Monitoring programme in order to early recognise the occurrence of new strains or human-adapted strains in food production.

The results of the 2021 Zoonosis Monitoring have also shown that a slaughter process hygiene criterion for *Campylobacter* which took legal effect four years ago has obviously not yet led to any improvements with regard to the high bacterial counts on broiler carcasses, as the percentage of neck skin samples with *Campylobacter* counts >1000 cfu/g has remained about as high as in the years before.

Lamb's lettuce, rocket salad, and other leaf lettuces in ready packs represent a possible source of human infection with potentially pathogenic germs such as STEC and *Bacillus cereus* in particular as they are consumed without prior cooking.

Examinations for resistance to antimicrobials produced no vital improvements in the 2021 Zoonosis Monitoring, as regards the occurrence of resistance in bacterial isolates obtained in the food chains linked with fattening pigs and with fattening calves/young bovines. This shows in the comparison of data about commensal and ESBL/AmpC-forming *E. coli*, among others. The data make clear that efforts to curb the use of antibiotics in animal farming by strengthening animal health must be further intensified, in order to achieve a decline in resistance rates. The focus should be placed here on reducing the use of critical antibiotics, namely such of EMA's Category B, or such classified as HPCIA substances by WHO.
The findings of the Zoonoses Monitoring put a sign where official food surveillance has to place the foci. They deliver important information helping government authorities to take suitable measures to reduce the occurrence of zoonotic pathogens.

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

Consumers can protect themselves from food-borne infections by thoroughly cooking meat and observing strict kitchen hygiene, which prevents transmission of pathogens from raw meat to ready-to-eat food (such as salad) during preparation of food. In order to prevent bacterial growth in meat and certain ready-to-eat foodstuffs, care should be taken to maintain cooling chains and fix appropriate, short best-before or use-by dates. 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 pose 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/VTEC, and

Listeria, as well as on how to protect oneself from food-borne infections in the private household (https://www.bfr.bund.de/de/start.html).