

The current SARS-CoV-2 pandemic demonstrated the potential risk posed by animal viruses that are not primarily human pathogens. The high adaptability of some viruses reflected by the spread to novel hosts is assisted by multiple factors directly or indirectly related to human activities such as wildlife trade, ecosystem disruption, live-animal markets, exotic food consumption, and intensified tourism. RNA viruses are very adaptable because of their error-prone replication process and the likelihood of genetic recombination or reassortment in some species. Even though, when compared to bacteria, food-borne virus transmission is not the attention focus, it may represent a way of pathogen introduction to the human population. Moreover, its relevance is enhanced considering that 75% of emerging infectious agents are of zoonotic origin. This review focuses on the zoonotic food-borne transmission of some viruses that may represent a risk for public health. Aside from the ability to replicate in the human GIT, the factors required for a virus to be transmissible via the zoonotic food-borne route include its stability and the potential to infect various hosts. Most food processing techniques are effective for virus inactivation, still, these are not applicable or performed for some foods. For example, the hepatitis E virus infects pigs, wild boars, and deer and is transmitted to humans through unprocessed meat. The Crimean-Congo hemorrhagic fever virus is a tick-borne virus that occurs in ruminants, while humans can get infected by consuming un-boiled milk and undercooked meat. Flaviviruses are mainly arthropod-borne, however, there have been reports of their transmission via the food chain. Although unlikely, the possibility of food-borne transmission for influenza A viruses has been studied and cannot be dismissed. Some paramyxoviruses, also missing the common characteristics of food-borne viruses, can be transmitted by the contamination of certain foods with animal excretions. The employment of the “One Health” concept, including constant epidemiological surveillance of animals and improved reporting of disease occurrence in humans, would reduce the overall risk of emerging viral diseases. Consistent application of hygienic measures is vital in facilities where animals are raised, or in which animal products are processed and sold. Thus far, a limited number of identified zoonotic food-borne viruses has been recognized, and the potential of certain viruses to be transmitted via this route should not be underestimated. Therefore, it seems reasonable to constantly update our knowledge on this matter, thus creating the basis for planning effective disease control strategies.

**Key words:** viruses, zoonotic food-borne transmission, one health

## Antimicrobial resistance in the food chain

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Antimicrobial resistance is now a major global public health issue often referred to as a „silent pandemic“. Food chain is, undoubtedly, considered a route of transmission for the resistant bacteria and/or resistant genes. However, the objective risk assessment evaluating food-borne antimicrobial resistance is still missing as many data gaps relating to reservoir, sources and transmission routes along the food chain are identified.

This review critically assesses and summarizes the information available in the literature on the emergence and spread of antimicrobial resistance throughout the food chain.

**Key words:** antimicrobial resistance, food chain

## Antimicrobial resistance from a food safety perspective: a situation in Slovenia

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Antimicrobial resistance (AMR) is an increasing global health problem that poses a serious threat to public health worldwide. AMR presents the risk not only to human health, but also to animal health and consequently to food safety problem.

In Slovenia, AMR of bacteria from food producing animals and food of animal origin has been regularly monitored for more than 20 years as part of the National control program of monitoring zoonoses and zoonotic agents. From 2013, Slovenia is included in the EU harmonised monitoring and reporting of AMR covering the following bacteria: *Salmonella* spp., *Campylobacter jejuni* and *Campylobacter coli*, indicator commensal *Escherichia coli*, *Enterococcus faecalis* and *Enterococcus faecium* and specific monitoring of the *E. coli* producing extended-spectrum  $\beta$ -lactamases (ESBL/AmpC) and carbapenemases. For monitoring AMR trends, sampling was performed in different animal populations and food categories. All samples were tested according to the standardized protocols and approximately 85 isolates per bacterial species were phenotypically tested for their AMR each year.

Multidrug-resistant *Salmonella enterica* subspecies *enterica* serovar *Infantis* became the emerging non-typhoidal *Salmonella* worldwide including Slovenia and was the most commonly reported serovar from broiler flocks and broiler meat. The highest levels of resistance of *Campylobacter* isolates in broiler meat were noted for ciprofloxacin, nalidixic acid and tetracycline. In livestock, methicillin-resistant *Staphylococcus aureus* was found only in pigs. A high proportion of ESBL/AmpC producing *E. coli* strains in retail poultry and pig meat samples and faecal samples was established, while the prevalence of vancomycin-resistant enterococci and high-level aminoglycoside resistant enterococci in poultry, pig and bovine meat was very low. The most common resistance traits observed in indicator *E. coli* isolates from broilers and pigs was resistance to ampicillin, sulfamethoxazole, trimethoprim and tetracycline. Also, resistance to ciprofloxacin and nalidixic acid was very common in poultry in pigs, moreover, increasing trends were observed in ciprofloxacin resistance from poultry samples in last few years. On the other hand, in Slovenia colistin resistance in indicator *E. coli* was not detected. Resistant bacteria from food producing animals and/or food of animal origin can be reservoirs of antimicrobial resistance genes, which can be transferred to humans via the food chain. Moreover, food producing animals and the retail meat might be an important vehicle for the community-wide dissemination of MDRB. Preventing and controlling AMR is a complex issue which involves many different sectors and requires a comprehensive approach and international cooperation.