Toxoplasma gondii in pork and pigs in Serbia – a real food safety hazard

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Toxoplasma gondii in pork and pigs in Serbia – a real food safety hazard

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Abstract. Infection with the apicomplexan protozoon *Toxoplasma gondii* is one of the most prevalent parasitic zoonotic infections globally, with existing seroprevalences varying between continents, countries, and even within countries and between individual communities. It is estimated that one third of the world's human population is infected with *T. gondii*, with many studies showing that the dominant mode of infection is consumption of undercooked meat harbouring *T. gondii* tissue cysts. Prevalences of infection in food animals in different countries range from 0 to 93%. Because of the absence of clinical symptoms in infected animals, and the unfeasibility of rapid and unequivocal detection of microscopic tissue cysts in pork, infected pigs remain unrecognized, and their meat becomes an essential source of infection for humans. The data on *T. gondii* infection in pigs in Serbia from several studies, as well as on the detection of the parasite in different food categories, from fresh pork to heat-treated products, are discussed.

Introduction

Among the pathogens transmitted through food, parasites occupy a significant place. Many parasitic infections pose a major public health challenge, among which the European Food Safety Authority has identified as critical risks *Cryptosporidium* spp., *Echinococcus* spp. and *Toxoplasma gondii* [1]. It is estimated that one third of the world's human population is infected with the protozoan *T. gondii*, making it the most widespread parasitic zoonosis globally [2]. Although the domestic cat and other members of the cat family are the only permanent hosts of *T. gondii*, many studies have shown that the dominant mode of infection for humans is consumption of undercooked meat (from pigs, lambs, cattle, and horses), and that differences in prevalence correlate with food preparation culture [3]. The World Health Organization (WHO) estimates that over 1 million cases of toxoplasmosis in the European region are caused by contaminated food every year [4]. The infection is peroral in over 90% of cases, i.e., caused by ingestion of contaminated food or water. Research indicates that 40-60% of these are infections are caused by consumption of contaminated meat, especially pork. Due to the absence of clinical symptoms in infected animals and the lack of

appropriate, specifically commercially feasible methods for rapid and unequivocal detection of microscopic cysts of *T. gondii* in meat [1], infected pigs remain unrecognized, and their meat becomes an essential source of infection for humans [5]. That is precisely why *T. gondii* remains one of the most studied parasites due to its importance for veterinary and human medicine.

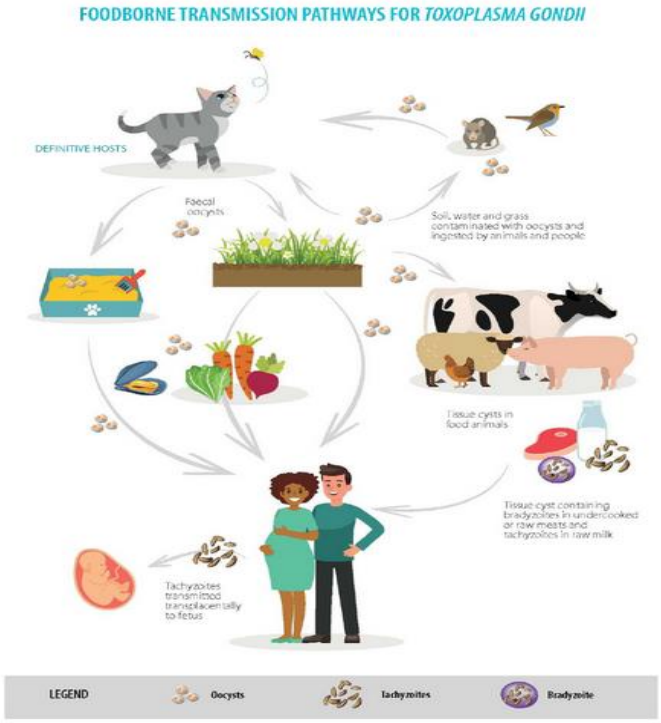

Figure 1. Foodborne transmission pathways for *T. gondii* infection [1]

Presence of *T. gondii* in pigs. What are the data for Serbia?

Traditionally, pork is the most preferred type of meat among domestic consumers in Serbia, corresponding to the volume of pig production in the primary sector. According to data from the Statistical Office of the Republic of Serbia, pigs bred in Serbia number about 3 million units, while about 2.2 million pigs are slaughtered annually in slaughterhouses [6]. Given the importance of *T. gondii* in the pig meat production chain, it is necessary to know the presence of this parasite in pigs at the national level. By considering risk factors and biosecurity systems on farms, whether and to what extent certain parameters affect parasite transmission among animals can be determined [7]. The prevalence of *T. gondii* can vary depending on the type of management practices used in the farms, the number of animals tested, and the age and type of the pigs tested (fattening vs. sows; indoor pigs vs. organic pigs) [8]; globally, including data from 47 countries from all continents, *T. gondii* prevalence in pigs averages about 19%, while the European average is 13% [9]. The first

seroepidemiological study in Serbia was conducted in 2002/2003 [10], when a seroprevalence of 28.9% (40.9% in weaned sows, 15.2% in fatteners) was determined, while a subsequent study in Belgrade showed a similar distribution of infection among age categories (30% in weaned sows, 8.3% in fatteners) with a total prevalence of 9.2% [11]. In the latest research in Vojvodina, an overall prevalence of 17% was determined in a total of eight farms, and viable *T. gondii* parasites were isolated from pig tissues [12].

Control of *T. gondii* in pork and pork products

Although predilection organs have been shown to be more parasite-laden than muscle tissue [13], an increasing number of studies have shown the presence of parasites in retail fresh pork [14,15]. In addition to fresh pork, *T. gondii* has been demonstrated in vacuum packaged meat; this packaging is used commercially for pork to enhance palatability and prolong shelf life. In control (non-vacuum packaged) pork stored at 4 °C, *T. gondii* survived storage for 28 days. In vacuum-packaged pork, *T. gondii* survived for 14 days but not 21 or 28 days [16]. Minced meat has also been investigated for the presence of *T. gondii*, as various commercial cuts are often used in mince production. In a study from Poland, *T. gondii* DNA was detected in 4.5% of 756 samples of retail minced pork and 5.8% of 1355 samples of raw sausage [17]. It has even been confirmed that the parasite survived in cured hams in Spain after 12 months of maturation [18]. On the other hand, three studies in America showed that *T. gondii* cannot survive salting procedures for ready-to-eat pork products [19, 20, 21]. However, all heat-treated products, cooked sausages, or products preserved by sterilization [22, 23] are free of *T. gondii* parasites; for example, Hill et al. [24] showed that *T. gondii* is killed in 5.6 minutes at 49 °C, in 44 seconds at 55 °C and in 6 seconds at 61 °C if the temperature is evenly distributed and maintained throughout the thickness of the meat. So far, there is no data on the detection of *T. gondii* in retail pork or pork products in Serbia.

Conclusion

All new knowledge on the transmission and risk factors for *T. gondii* infection is vital for improving educational programmes for groups of people considered to be at high risk concerning infection with this parasite, primarily pregnant women (because of the risk to the foetus) and immunocompromised persons. For food to be safe for consumption, it is necessary to carry out actions and activities to prevent or eliminate food safety hazards following the *Codex Alimentarius* [25]. The purpose of control measures is to produce food that is safe and suitable for human consumption. To prevent foodborne toxoplasmosis, one should follow the WHO five keys [4] to safer food.

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