Isolation of *Streptococcus* species from the tonsils of slaughtered pigs

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Several *Streptococcus* species can be found in the tonsils of clinically healthy pigs; however, some of them, such as *Streptococcus suis*, *S. porcinus*, and group C streptococci, are potential pathogens. Katsumi et al. (1) reported that the causes of endocarditis in 51.5% of 495 pigs were *Streptococcus* species, particularly *S. suis*, *S. dysgalactiae*, and *S. porcinus*. In another study, the same research group reported that the main bacterial species in slaughtered pigs with endocarditis, arthritis, or lymphadenitis was *S. dysgalactiae* (2).

Among the *Streptococcus* species, *S. suis* is a particularly important pathogen for the swine industry. It causes meningitis, arthritis, endocarditis, pericarditis, bronchopneumonia, abortions, septicemia, and sudden death in pigs (1,3,4). Based on specific capsular polysaccharide antigens, 35 different serotypes (serotypes 1 to 34 and serotype ½) have been identified. Wide variations have been reported in the virulence between serotypes, as well as within each serotype (5–7). *S. suis* colonizes the upper respiratory tract, particularly the palatine tonsils and nasal cavities, as well as the genital tracts of both infected and clinically healthy swine. It is usually transmitted nasally or orally (5,8–10). The diagnosis of the infection is performed by isolation of the agent by conventional methods and serotyping based on polysaccharide capsular antigens (5,6,11). It has been indicated that sampling from palatine tonsils is the most reliable way for the detection of both infected and carrier pigs (8,11). *S. suis* is a conspicuous agent for public health because of its well-known zoonotic potential. It causes meningitis, followed by septicemia and endocarditis in humans. It has been indicated that those people in close contact with pigs or pig meat are at risk of *S. suis* infections (8,12).

In Turkey, pig farms and slaughterhouses are not routinely tested for the presence of pathogens such as *S. suis*, *Actinobacillus pleuropneumoniae*, or *Mycoplasma hyopneumoniae* due to limited facilities and the inadequacy of knowledge and experience of veterinarians in the swine industry. However, recent developments in this industry in Turkey showed the necessity of detailed studies on this species. The aim of this study was to investigate the occurrence of *S. suis* and its predominant serotypes in Turkey, as well as those of other streptococci. The palatine tonsils from pigs at the slaughterhouse were used for the isolation of the bacteria.

The palatine tonsils of 220 pigs from 10 different pig farms, aged between 3 months and 3 years old, were removed aseptically after slaughter and transported to the laboratory within sterile bags in a cold chain. The tonsil samples were submerged for 7 s in boiling water in order to avoid possible contaminations, placed in polyethylene.
Streptococcus suis was not detected among the 220 palatine tonsils tested. However, various Streptococcus spp. were isolated from 96 tonsil samples. S. porcinus was the most common streptococcus recovered and was isolated from 68 (31%) pigs. From the samples, S. agalactiae was isolated from 19 (8.6%), S. equi subsp. zooepidemicus from 10 (4.5%), S. uberis from 6 (2.7%), S. dysgalactiae subsp. equisimilis from 4 (1.8%), Enterococcus faecium from 4 (1.8%), and S. pyogenes from 1 (0.5%).

Although streptococcal and enterococcal bacteria are found in the tonsils, intestines, or feces of clinically healthy pigs, S. porcinus, S. pyogenes, and group C-belonging S. equi subsp. zooepidemicus and S. dysgalactiae subsp. equisimilis are potential pathogens (5,10).

Aarestrup et al. (9) reported that 265 S. suis samples were recovered from pigs within a 2-year period in a Danish veterinary laboratory. Clifton-Hadley et al. (15) isolated S. suis from a proportion of pigs from 12 herds with a history of the disease and from 3 herds believed to be free from the disease. In Australia, tonsils collected at slaughter from 188 pigs originating from 3 herds known to be free from the disease was isolated in 76% of the samples (14). Kataoka et al. (16) examined 291 palatine tonsils of clinically healthy pigs brought into a slaughterhouse for the presence of S. suis serotype 2, and it was isolated from 40 (13.7%) of them. A total of 200 nasal and tonsil swabs from pigs slaughtered and sold in the Philippines were examined for the presence of pathogenic streptococci. Out of the 200 pigs, 136 E. faecalis and 24 S. dysgalactiae samples were isolated, while S. suis, S. porcinus, and S. pyogenes were not isolated (17).

In the present study, S. suis was not recovered from the 220 pigs examined. This result offers indications that it may not be present in pigs in Turkey. In Turkey, there are a limited number of pig farms, and these farms are separated from each other and contain very small pig populations. Accordingly to the Turkish Statistical Institute, the number of raised pigs was 1558 in 2010 (18). Therefore, it is suggested that the negative isolation result might be due to these conditions. The farms were located mostly in the western part of Turkey. The farmers informed us that there was no transportation from other countries and that all of the animals originated from Turkey. Furthermore, there is no information on the occurrence of S. suis infection in neighboring countries such as Greece (19), Bulgaria, or Georgia.

In Turkey, there are no pure-bred pigs and no studies of the species or genotypic properties of the current pigs. Therefore, it is possible that resistance factors originating from genotypic properties might be acting in the protection against disease. Additionally, since this study was not focused on specific serotypes, conventional isolation procedures were followed and a specific hyperimmune sera addition or immune magnetic separation could not be used. In most countries, all of the pigs pass through a scald tank, in which the water is at approximately 60 °C, and it has been reported that S. suis could survive for up to 10 min at this temperature (15). Cleaning processes are performed manually and the temperatures of the scald tanks are kept at about 70 °C or higher in Turkey. The high-temperature processing in this study might have influenced the isolation chance negatively.

Another reason for the lack of isolation might be preventive antibiotic usage at the farms. Unfortunately, it is almost impossible to discuss this possibility due to the lack of information about the antibiotic usage for any health problems of the pigs at the farms sampled. The only definite information about the management was that no vaccination protocol had been performed at any of the farms.

S. porcinus can be isolated from the tonsils, pharynx, and nasal cavities of clinically healthy pigs; however, it causes contagious streptococcal lymphadenitis in pigs characterized with abscesses in the cervical, mandibular, and cephalic lymph nodes. Carrier pigs harbor S. porcinus in their tonsils and readily transmit the organisms to susceptible pigs via nose-to-nose contact and by contamination of water and feed. It has been isolated from pyogenic infections in humans (10). The isolation of S. porcinus from pigs, with a 30% isolation rate in the current study, indicates that S. porcinus is common among the pigs in Turkey.

Streptococcus equi subsp. zooepidemicus has been isolated from a wide range of animal species, such as horses, cats, dogs, and pigs, and it could cause endocarditis, pneumonia, meningitis, septic arthritis, and cerebral adenitis in humans (10). In Hong Kong, the chromosomal DNA of S. equi subsp. zooepidemicus isolates from humans and pigs was compared by HindIII restriction endonucleases, and it was found that the human and pig isolates were identical (20). The S. equi subsp. zooepidemicus isolation rate (4.5%) in this study was found to be meaningful among the pigs in Turkey. In this study, the presence of S. dysgalactiae subsp. equisimilis, which causes sporadic septicaemia, arthritis, and endocarditis in pigs, was determined with a low isolation rate (1.8%).

In conclusion, although the results of the study suggest the absence of S. suis infection in pigs in Turkey, further studies on this disease and other infectious diseases should
continue. We were able to confirm for the first time the presence of *S. porcinus* in pigs bred in Turkey. This is an important finding, taking into account that *S. porcinus* is a potential pathogen both for humans and pigs.

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**References**
