Zoonotic foodborne pathogens in rural cattle

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Research focus area: Red Meat Safety, Nutritional Quality and Value

Full title

Molecular surveillance of zoonotic foodborne pathogens associated with red meat produced in South African rural abattoirs: knowledge as part of the solution

Aims of the project

- To isolate Campylobacter spp, Salmonella spp., E. coli O157; non-O157 shiga toxin producing E. coli, Shigella, Listeria monocytogenes and Yersinia enterocolitica from hides, carcasses, rectal swabs and water used during cattle slaughter in rural abattoirs.
- To isolate Campylobacter spp, Salmonella spp., E. coli O157; non-O157 shiga toxin producing E. coli, Shigella, Listeria monocytogenes and Yersinia enterocolitica from cattle faeces in communities that supply rural abattoirs so as to assess potential risk to public health.
- To determine antibiotic resistance patterns of all the representative isolates obtained from this study.
- To identify the isolated Campylobacter spp, Salmonella spp., E. coli O157, non-O157 shiga toxin producing E. coli, Shigella, Listeria monocytogenes and Yersinia enterocolitica using PCR and to apply PCR-RFLP for establishing the relatedness of isolates for epidemiological purposes.
- To assess the risk of the above mentioned isolates in rural communities.

Executive summary

Contaminated red meat and meat products have been linked to numerous foodborne illnesses worldwide. The red meat is usually contaminated by zoonotic pathogens, which continue to pose a heavy socio-economic burden among people of many nations in general, and inhabitants of rural areas in developing countries in particular (Seimenis, 1998; Michel et al., 2003). Some of the zoonotic pathogens that are frequently isolated from red meat include Salmonella spp., Campylobacter spp. and Escherichia coli. In addition, some bacteria such as Shigella spp, and Listeria monocytogenes have been associated with contamination of red meat and cattle feces.

The foodborne zoonotic pathogens are perpetuated by the close proximity of animals and humans, consumption of contaminated animal products, improper disposal of waste and illegal slaughtering (Seimenis, 1998). 997). Contamination of carcasses usually occurs through contact with the external surface such as the gastrointestinal tract during evisceration and when the hide is removed (Nottingham, 1982; Bonardi et al., 2001). In addition, contaminated equipment, utensils and worker's hands may also be responsible for transmission of pathogens (Mackey and Derrick, 1979). Such contamination usually begins at the slaughterhouse, despite the fact that the roots of contamination are present prior to slaughter (Brabban et al., 2004). Surface drinking water contaminated with cattle waste may also perpetuate the spread of zoonotic pathogens as exemplified by E. coli O157:H7 outbreaks that affected thousands of people in South Africa and Swaziland in 1993 (Isaacson et al., 1993).

In South African communal areas, slaughter of either cattle or goats do not involve any meat inspection and safe meat handling may not be practised (Michel et al., 2003). In addition, some African cultural practises are usually carried out at household level and are not subject to hygienic scrutiny. For these reasons, rural communities are usually exposed to a plethora of meat-related foodborne pathogens, which impacts negatively on their public health (Michel et al., 2003). Despite the Meat Safety Act of 2000, which was drafted by the Ministry of Agriculture of South Africa that incorporates low throughput red meat abattoirs and provides specific requirements for them (Michel et al., 2003), contamination of carcasses by bacteria is a complex process, as healthy cattle usually form the reservoirs of some of the zoonotic pathogens such as E. coli O157 (Martin et al., 1986).

While there has been sufficient surveillance of diseases and hygiene measures among commercial farms (Michel et al., 2003), there is need to obtain such information from the

communal cattle producers. Such information will enable the implementation of uniform hygiene standards in the meat-trading sector. Laboratory-based surveillance of cattle after slaughter is paramount in the detection and curbing of foodborne pathogens from entering the food chain. For this purpose, classical microbiological techniques may be used for characterization of the foodborne pathogens responsible for contaminating red meat. Despite the numerous advantages of classical microbiological methods, these techniques are mainly useful for screening purposes and they may not be suitable for unequivocal identification of pathogens. Alternatively, nucleic acid-based molecular methods have been shown to be more accurate, fast, sensitive, and reproducible for the diagnosis of many bacteria. However, due to the inherent limitations that are associated with any technique, a polyphasic approach that involves both classical and molecular-based techniques are effective in accurate characterization of bacteria. As the use of antibiotics to treat animals and humans may result in drug resistant strains (Trevejo et al., 2005), it is imperative to carry out antibiotic susceptibility tests on foodborne pathogens to ascertain their antibiotic susceptibility.

The aim of this project is to determine the prevalence, antibiotic susceptibility and relatedness of E. coli O157, non-O157 STEC, Salmonella spp., Campylobacter spp., Listeria monocytogenes and Yersinia enterocolitica isolated from hides, carcasses, rectal swabs and water used for final carcass wash in rural communities of South Africa. Cattle faeces obtained from associated rural communities will be analysed for the same pathogens to assess their potential risk in communities. For this purpose, a polyphasic approach that involves classical microbiological techniques, PCR and PCR-restriction fragment length polymorphism of selected amplified genes will be used. Such information is useful for raising public awareness regarding the direct link between hygienic slaughter of animals and the production of safe red meat. The information is also important for drafting a multi-disciplinary approach that includes hazardous analysis and critical control points (HACCP) guidelines for circumventing contamination of meat (Brabban et al., 2004).