INTERNATIONAL JOURNAL OF
Food Microbiology

ELSEVIER

International Journal of Food Microbiology 66 (2001) 79–83

www.elsevier.nl/locate/ijfoodmicro

Control of VTEC in Dutch livestock and meat production

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Abstract

The Dutch government and the meat industry, recognising VTEC as having important public health, meat quality and economic implications, have taken a number of initiatives within the last 5 years to control VTEC in livestock and meat. These initiatives, brought together last year in a ‘Masterplan VTEC’, include short-, middle- and long-term priorities. Short-term priorities include advice on interventions in the cases of an outbreak of VTEC associated with a cattle herd, the implementation of handbooks for Good Manufacturing Practice (GMP) in slaughterhouses and deboning plants, and the execution of an action programme on zero-tolerance to faecal contamination of carcasses. Mid-term activities include surveillance of the occurrence of VTEC and other enteropathogens in livestock and meat, and the investigations of VTEC population dynamics in dairy farms, transportation and farm hygiene. In the longer term, this programme aims to produce a system of Integrated Quality Assurance, consolidating effective measures to control VTEC in Dutch livestock and meat, and integrating emerging means for control and prevention. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: VTEC O157; STEC O157; Cattle; Meat; Control

1. Introduction

In the Netherlands, verocytotoxin-producing *Escherichia coli* (VTEC) have been annually associated with a few dozen cases of hemolytic uremic syndrome (HUS) and an unknown number of cases of human gastroenteritis. In approximately 90% of the above cases of HUS, the presence of VTEC, usually serotype O157, has been confirmed (Van de Kar et al., 1994). Since 1999, VTEC O157 infections have been systematically identified and investigated, and the first findings from such studies are now available (Van Duynhoven et al., 2000), reporting 37 laboratory confirmed cases of VTEC O157 infection during 1999. Such reports imply an incidence of VTEC O157 infections of one to two cases per 1 000 000 inhabitants per year in the total population. This is similar to the incidences in a number of other continental European countries, including Finland, Denmark, Austria, Italy and Spain, but lower than a number of other countries, i.e. Germany, Sweden, Belgium and the UK, where much higher incidences have been reported (e.g. up to 20 cases per 1 000 000 per year in the UK) (Ammon, 1997). Although systematic surveillance has only been recently introduced, and thus historically reliable data are limited, there is no evidence that the incidence of HUS is

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PII: S0168-1605(00)00488-8

currently undergoing significant increase. In more general terms, retrospective investigations have shown that VTEC O157 has been causing HUS in the Netherlands since at least 1974 (Chart et al., 1991).

Only two small outbreaks of VTEC O157 infection have been described in the Netherlands. The first was in June, 1993, when four children where infected by VTEC O157 after a visit to a recreational lake. All four children developed HUS but subsequently achieved full recoveries. The most likely source was lake water, but this could not be confirmed by bacteriological examination (Cransberg et al., 1996). In the second outbreak (April, 1998), VTEC O157 infection occurred within a farm family, involving one of the parents and four of six children. All five patients developed hemorrhagic colitis, and one child (a 4-year old boy) developed HUS after a 2-week asymptomatic episode. VTEC O157 isolated from the patients had PFGE signatures which were similar, but not identical, to VTEC O157 isolates from veal calves on their farm. Interestingly, the family members were not in close contact to the animals, but had employed someone else to take care of the animals. This person and his family did not show any signs of VTEC infection. The history of the outbreak in this family suggested person-to-person transmission but the true route of transmission could not be fully established (Heuvelink et al., 1998b).

As noted above, the general incidence of VTEC O157 infections is rather low. Nevertheless, the implications of such infections can be quite severe, both for the patient and the meat industry. Since the organism is primarily associated with cattle, the damage to the Dutch meat industry, which is an important economic factor in the Netherlands, could be large. In the past 5 years, a number of initiatives have been taken by researchers, government and industry to facilitate cooperation between research groups and to disseminate advice on the control of VTEC in Dutch livestock and meat industry. These have resulted in the founding of a VTEC research group (in 1996), an industrial platform VTEC (in 2000), in which research organisations, industry, product boards and ministries participate, and a special committee to disseminate advice on veterinary hygienic measures towards VTEC O157-positive animals and farms (in 1998). A ‘Masterplan VTEC’ (1999) brought out to give an overview of the current research and to facilitate new initiatives for research, recognised short-, middle- and long-term priorities. This paper reviews the current initiatives to control VTEC in the Dutch livestock and meat industry.

2. Dutch livestock as a source for human VTEC O157-infections

As in many other countries, cattle and other ruminants seem to be important sources for VTEC O157. At the slaughterhouse, this pathogen has been found in the intestinal contents of 10–11% of sampled cattle. In addition, 4% of the sheep and lambs carry VTEC O157 in their intestines at slaughter, and VTEC O157 has been found in 0.5% of veal calves (Heuvelink et al., 1998a).

VTEC also appears to occur frequently on farms, as demonstrated by a small survey of 13 dairy farms, which found DNA sequences encoding genes for verotoxin-production (*vt*1, *vt*2) in bovine faecal samples from all the farms examined (Reinders and Bijker, 1999). This study also simultaneously detected DNA-sequences encoding genes for adhesion (*eae*A) in samples from 11 of the 13 dairy farms, indicating that potential enterohemorrhagic *E. coli* are present on most dairy farms.

Frequent isolation of VTEC O157 from cattle suggests that these animals are an important potential source of human infection with this pathogen. Results from phage-typing support this suggestion, as all the phage/*vt*-types isolated from human patients by Heuvelink et al. (1995) have also been isolated from cattle (Heuvelink et al., 1998a; Reinders and Bijker, 1999). However, more recent data from 29 patients with laboratory-confirmed VTEC O157 infection (Van Duynhoven et al., 2000) could not establish a particular association with cattle, either through direct contact with the animals or their products (meat, milk or manure). Thus, other non-bovine, sources should not be overlooked (Chart, 1998). Hopefully, data collected in the future will clarify the main sources of sporadic VTEC O157 infection in the Netherlands.

3. Short-term priorities

3.1. An outbreak associated with a cattle herd

Short-term priorities include immediate measures to deal with acute situations. In 1998, at the suggestion of the Health Inspectorate, a committee was formed to advise on veterinary hygiene measures in dealing with VTEC O157-positive animals and farms. Their advice considered a hypothetical case implicating VTEC O157 in an outbreak of hemorrhagic colitis, with or without HUS, in children, in which preliminary investigations had identified beef or a cow from a known farm as the source of infection. In this scenario, where the farm probably harbours high-risk materials, the infection should be contained and further spread of VTEC O157 from the farm should be prevented. The imposition of quarantine means that animals or animal products (with the exception of milk) should not be removed as long as a farm is considered positive. Milk from such farms should be pasteurized before removal. Manure should be stockpiled, and if necessary, treated. Such stored manure should only be spread on land after bacteriological analysis has confirmed that it is free from VTEC O157.

Within the farm itself, contaminated materials should be contained in a format which prevents growth of the pathogen and prevents animal-to-animal transmission. This can be achieved by a range of hygienic measures, including separation of animals of different age groups, frequent cleaning and disinfection of water troughs and bowls, rapid removal of feed remains and strict personal hygiene among farm workers. All animals on the farm should be sampled every 2 weeks, as frequent and repeated bacteriological examination is necessary to accurately determine that each animal is truly free from VTEC O157, rather than merely intermittently shedding the pathogen. In general terms, a farm may be considered free of VTEC O157 when all samples are negative for VTEC O157 over two subsequent samplings. Animals which are long-term shedders (more than 6 weeks, three subsequent samples) should be removed. It should be noted that shedding could continue for extended periods of time. For example, continuous shedding of VTEC O157 in samples tested every 2 weeks for periods in excess of 4 months, has been observed (Reinders and Bijker, 1999).

3.2. Preventive measures at slaughter

A range of other measures are currently included within the action programme on zero-tolerance to faecal contamination of carcasses (Heuvelink et al., 2001, this issue), and within Good Manufacturing Practice (GMP) handbooks for slaughterhouses, and beef and veal deboning plants (Burt et al., 1997; Burt and Bijker, 1997). The GMP handbooks give directions in relation to strict hygiene during slaughter and deboning, as well as methods for control/monitoring of these processes, to continuously improve the hygienic performance of the meat production processes.

4. Mid- and long-term priorities

Mid-term measures include surveillance of VTEC in the animal population and food, as well as studies of farm hygiene (i.e. on farm niches for growth and survival of VTEC), transportation (i.e. the effects of stress during transport on the shedding of VTEC, and the effects of grouping of animals in the spread of VTEC between herds or among animals entering slaughter facilities) and population dynamics on dairy farms (i.e. the duration of shedding by individual animals, and the extent of on-farm VTEC transmission among animals).

Long-term measures include the integration and application of the results from the above surveys and experiments in improved plans for prevention of VTEC dissemination and survival, perhaps within an overarching system of Integral Quality Assurance. Such systems include strict hygiene measures for feed supply, animal husbandry and transportation, and pays particular attention to close control of production chains. Systems of this type have already been introduced for cattle (1996) and veal calves (1997).

Scientific progress in such areas as the development of probiotics, improved feed control and vaccination may, in the longer term, contribute to the elimination of VTEC from Dutch livestock and meat.

5. Discussion

Evidence for a pivotal role of cattle in the epidemiology of VTEC is accumulating. However, a direct link between a bovine source and human infection has not been fully established in the Netherlands. Indeed, recent data (Van Duynhoven et al., 2000) do not particularly support the suggestion of a direct link from cattle. The effect of control measures in the animal husbandry and meat industry on the number of VTEC infections in humans is, therefore, not yet clear. However, if the bovine reservoir is of major importance to the occurrence of VTEC infections in humans, reduction of the prevalence of this organism in cattle is the most effective means to control its spread through meat or other transmission routes. The efficiency of the currently applied and suggested measures is still to be established.

VTEC O157 seems to be ubiquitous in the environment. Bearing this in mind and even allowing for seasonal fluctuations, herds are constantly exposed to contamination with this organism. In overall terms, strains of VTEC O157 come and go within herds. Some strains are present for short periods, while others are more persistent (Hancock et al., 1998; Reinders and Bijker, 1999). A farm can thus acquire new strains soon after completion of a programme of eradication (of the type suggested in the short-term priority section). Despite the possibilities of (re)infection, eradication programmes should be carried out after a herd has been linked to an outbreak. In more general terms, such programmes can help to understand the ecology of VTEC O157 in the farms and will provide information about the feasibility and longer-term efficiency of the suggested measures. Such information should also be of value in attempts to reduce the rates of (re)occurrence of VTEC among the total cattle population.

To date, the emphasis has been on the development of hygienic measures to limit or prevent the spread of VTEC on the farm and during processing, as demonstrated by the zero-tolerance programme and GMP-handbooks for slaughter and deboning processes. However, mathematical simulations have demonstrated that the greatest potential impact in controlling VTEC should be expected from vaccination or from agents that reduce the shedding of VTEC O157 in faeces (Jordan et al., 1999). The overall impact of other pre-slaughter measures has been estimated to be much smaller, as long as the general prevalence remains at the current levels (Jordan et al., 1999). It remains to be seen whether or not adequate vaccines and/or agents to reduce shedding can be developed and effectively applied.

Finally, current research has focussed mainly on serotype O157. It should be remembered that other serotypes have also been found in HUS and gastroenteritis patients. Study of the epidemiology of these other potentially significant VTEC serotypes can only proceed when an adequate range of suitable detection methods has to be developed.

Acknowledgements

This work was supported by the Ministry of Agriculture, Nature Management and Fisheries (The Hague), the Ministry of Health, Welfare and Sport (The Hague), and the Product Boards for Livestock, Meat and Eggs (Rijswijk). We thank Dr. André Henken for reviewing the manuscript.

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