YERSINIA CONTAMINATION ON PIG CARCASSES IN RELATION TO SLAUGHTER TECHNIQUE

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INTRODUCTION

In the Danish population approx. 2,000 cases of Yersiniosis are discovered every year. The real number may be much higher since only the most serious cases are discovered. In a serological survey 7.7% of a randomly selected adult Danish population consisting of 928 persons were found to have an elevated Yersinia enterocolitica serotype 0:3 titer (Agner, 1983). Of the human pathogenic serotypes only serotype 0:3 seems to be of importance in Denmark (Anon., 1987).

Examination of various animals and food items indicates that healthy pigs constitute a major reservoir of the human pathogenic Yersinia enterocolitica serotype 0:3 (Wauters, 1979; Pedersen, 1979; Christensen, 1980; Doyle et al., 1981; Schieman and Fleming, 1981; Nesbakken and Kapperud, 1985; Nesbakken, 1985), and a recent investigation showed that more than 80% of Danish pig herds are infected (Andersen, 1984). Further evidence to suggest that pigs are the reservoir for human infections with Yersinia enterocolitica has been obtained by biochemical, serological, phage and plasmid typing methods which show the human and porcine strains to be indistinguishable (Wauters 1970+1979; Hurwell, 1981; Kapperud and Nesbakken, 1987; Shiozawa et al., 1987).

The present investigation was carried out to estimate the source and extent of contamination with Y. enterocolitica 0:3 on the surface of pig carcasses and, if possible, to recommend changes in the slaughter technique in order to reduce contamination.

MATERIALS AND METHODS

The investigation was carried out in a medium-sized Danish abattoir with one slaughter line and a capacity of approx. 300 pigs/hour.

Yersinia sampling was performed on three groups of carcasses (A, B and C), which were eviscerated by different techniques as follows:

Group A: Manual rectum loosening

Manual rectum loosening was the traditional way of evisceration in Danish slaughter plants until 1987.

Manual evisceration is performed as follows: The left hand helps to guide the knife (held in the right hand) during the careful incision dividing the medial hind legs and opening the pelvis by cutting through the cartilage of the pelvic symphysis. The anus is then circumcised with the assistance from one or two lefthand fingers placed in the anus, and finally the rectum and anus are pulled out between the hind legs.

Group B: Mechanical rectum loosening

The rectum loosener (manufactured by Jarvis, Middletown, Connecticut, USA) is nowadays used in all Danish slaughter plants.

The loosener consists of a probe and a sharp rotating cylinder. The probe is inserted in the anus and rectum is fastened by vacuum while the cylindrical knife cuts around the anus. Rectum and anus are then drawn through the pelvic duct by a pull in the intestines. The rectum loosener is decontaminated in 82°C hot water after each operation.

Group C1 and C2: Mechanical rectum loosener and enclosure of the anus

Having circumcised rectum with the Jarvis loosener the rectum is positioned manually into a plastic bag.

During the two first tests in this group the plastic bag application was used after rectum and anus had been pulled through the pelvic duct (group 1). In the following tests the plastic bag was applied before anus and rectum was pulled through the pelvic duct (group 2).

On each day of sampling approx. 100 carcasses from one of the groups A, B and C were sampled. In order to minimize the influence of herd variations in infection rate, sampling was performed on only two or three carcasses from each herd. Sampling was started in the morning and went on for approx. 3 hours. During the sampling period all pigs on the line were eviscerated in the same manner.

Sampling was performed with moistened swabs and two swabs were used for each sample site. After sampling the two swabs from each sample site were combined and incubated in 10 ml enrichment medium.

Samples were taken from the rectum, the medial face of the hind legs and the cut face of the sternum and surrounding tissues. At a later stage in the investigation the pelvic duct was included.

Sampling from the rectum was carried out on the slaughterline just before the evisceration was initiated. At this sampling the two swabs were used simultaneously as a spoon, in order to remove a small amount of faeces from the rectum.

Sampling from the other sample sites was performed after the carcasses had passed the complete slaughter process and were ready to be chilled. At these sample sites an area of approx. 50 cm^2 on each carcass half was swabbed with a moistened swab.

Cultivation methods

The two swabs from each sample site were placed in 10 ml enrichment medium. The medium was phosphate-sorbitol buffer (Schiemann, 1982) which was incubated at 4 °C until subcultivation which was performed after 1 as well as after 3 weeks.

Subcultivation was carried out on Cefsulodin-Irgasan-Novobiocin agar (CIN-agar). (Yersinia Selective Agar Base, Oxoid code CM 653, with Yersinia Selective Supplement, Oxoid code SR 109.)

Suspect colonies were subcultured and verified according to the biotyping scheme of Wauters (1981). Finally slide agglutination was performed with O:3 antiserum.

RESULTS

The table presents the proportion of sample sites where Yersinia enterocolitica serotype O:3 has been isolated in relation to the evisceration technique:

Evisceration technique	Percentage isolated from				Total number of carcasses
	Rectum	Medial hind leg	Pelvic duct	Split sternum	
Group A	27.2	25.7	-	13.9	323
Group B	24.9	6.0	12.3 *	8.7	530
Group C1	18.2	3.0	-	5.5	198
Group C2	17.9	1.9	0.9	2.2	314
Total					1,365

* The sampling of the pelvic duct in group B was performed in the last 3 tests only and on a total of 311 carcasses.

DISCUSSION

In this survey pathogenic Yersinia enterocolitica 0:3 were isolated from the rectum of 313 pigs (22.9% of the faecal samples). This frequency is higher than shown in earlier investigations.

Fukushima et al. (1983) found 7.1% of faeces samples from five farms infected, with as many as 14.6% infected in one of the farms. Weber and Knapp (1981) studied the variation in infection rate from month to month and found a peak in January with 14% (13 of 95) infected, with a mean of 2.7% (33 of 1,206) infected throughout the year. Maryama (1987) examined caecal contents at 41 abattoirs and found a constant high percentage of infected pigs; out of 9,423 pigs examined, 1,114 or 11.8% were found infected with the human pathogenic serotypes 0:3, 0:9 or 0:5,27.

The results of the investigation presented here showed that the Yersinia enterocolitica 0:3 contamination on the sites of the examined pig carcasses is highly correlated with the evisceration technique.

Manual rectum loosening resulted in the highest contamination rate both on the medial face of the hind leg and on the cut face of the sternum. The reason for this can be that the operative first puts his fingers into the rectum to facilate the incision and then uses the same fingers to guide the knife, thus systematically contaminating the medial face of the hind leg.

The use of a rectum loosener lowered the contamination on the medial face of the hind leg as well as on the sternum. However, the use of this technique seems to cause some contamination in the pelvic duct. This can be explained by the fact that the rectum is removed through the pelvic duct when the rectum loosener is used, whereas it is pulled out between the medial faces of the hind legs when the pigs are eviscerated manually.

When the rectum was enclosed in a plastic bag as in test group C the contamination rate on all sample sites was reduced. This effect was even more pronounced when the plastic bag was applied before the rectum was pulled through the pelvic duct.

This investigation shows that the presence of Yersinia enterocolitica 0:3 on the surface of the carcass is closely related to the contamination of the carcass with faecal material during slaughtering and especially during the evisceration procedure.

With this in mind, an attempt is presently beeing made to improve the evisceration technique. Trials are in progress in which the rectum and anus are enclosed automatically in connection with the mechanical rectum loosening.

Unfortunately this has been quite difficult to achieve and a solution to this problem has not yet been found.

In the meantime an attempt is being made to change the handling of the anus in order to minimize contamination of the carcass.

It is well established that the pig tonsils also constitute a major and important reservoir for the human pathogenic Yersinia enterocolitica 0:3 (Christensen, 1980; Szita et al., 1980; Schiemann and Fleming, 1981; Fukushima et al., 1983; Andersen, 1984). An investigation of the importance of this region as a source for carcass contamination will be made in a further series of tests.

A fuller account of the data is presented in "Contamination of freshly slaughtered pig carcasses with human pathogenic Yersinia enterocolitica", Andersen, J.K., International Journal of Food Microbiology 7 (1988), 193-200.

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