E. coli 0157:H7 IN FERMENTED MEATS

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Background: *E. coli* 0157:H7 is an emerging food poisoning pathogen which can cause a severe and potentially fatal illness called haemorrhagic colitis (Padhye and Doyle, 1992). Research to date suggests that this organism is persistent in the environment and can survive refrigeration (Abdul-Raouf *et al.*, 1993), freezing (Doyle and Schoeni, 1984), high salt concentration (6.5%) (Glass *et al.*, 1992) and low pH 4.7 (Abdul-Raouf *et al.* 1993). *E. coli* 0157:H7 is reportedly present at a level of 3.7% in ground beef samples (Doyle and Schoeni, 1987). Recent food poisoning outbreaks have linked this pathogen with fermented ready-to-eat products (Stentz, 1995). This type of product had not previously been implicated in an outbreak of *E. coli* 0157:H7 and there is little information on the risks associated with the manufacture and processing of fermented meats.

Objectives: To determine the incidence of *E. coli* 0157:H7 on fermented meats sold in Irish retail outlets and to investigate environmental and biochemical factors affecting the growth and survival of *E. coli* 0157:H7 during processing of fermented meats. The aim of the project is to identify risks associated with current processing techniques and to recommend changes required to produce a safer product, whilst still maintaining product quality and consumer acceptability.

Methods: Salami (n= 56) and pepperoni (n=6) samples were purchased from retail outlets in the Dublin area and examined for the presence of *E. coli* 0157:H7. Both direct count and enrichment methods were used to examine the samples. The growth and survival of *E. coli* 0157:H7 in fermented meats was also investigated. The strain of *E. coli* 0157:H7 used in this experiment was from the food poisoning outbreak associated with salami in the USA in 1994. Pepperoni was inoculated with *E. coli* 0157:H7 (10^7cfu ml^{-1}) and at various stages during fermentation and drying examined for the presence of the pathogen. The influence of different product formulations including pH (4.4 - 5.2), sodium nitrite (100 - 300 ppm) and salt (2.5 - 4.8%) on *E. coli* 0157:H7 survival were determined. The possibility of employing an additional hurdle in the process ie. a heat step between the fermentation and drying stages was established by determining the heat resistance of *E. coli* 0157:H7 in fermented meat. The effect of three different heating temperatures 55, 55 and 60 °C on three different strains of *E. coli* 0157:H7 was established. Two of the strains used were from food poisoning outbreaks {"salami" and "Jack in box" (JIB)} while the third was a control strain (NCTC 43895). Salami samples (9.9g) were placed in vacutainers, inoculated with *E. coli* 0157:H7 (10^6 cfu ml^{-1}) and placed in a water-bath at the appropriate temperature. The salami samples were examined for *E. coli* numbers at various time intervals and D values calculated.

Results: *E. coli* 0157:H7 was detected in 3 of the 56 retail samples examined (5.35%) (Table 1). The numbers present were low (< 5 per gram) and were detectable by enrichment only. Studies on the survival of *E. coli* 0157:H7 in a standard pepperoni production process showed that fermentation reduced the pathogen numbers by $\log_{10}$0.39cfu/g while the drying process resulted in a further $\log_{10}$1.08 reduction (Fig 1). The largest drop in pathogen numbers occurred between 144 and 240 mins and this corresponded with a drop in water activity from 0.87 to 0.77. At extremes of pH (4.4), salt (4.8%) and sodium nitrite (300 ppm) the pathogen numbers were significantly reduced (4 log reduction) but the growth of the starter culture was also inhibited resulting in non-fermentation of the pepperoni. A combination of lower pH (4.4) with higher levels of sodium nitrite (300ppm) gave the best result. Fermentation reduced the numbers by $\log_{10}$0.95 cfu ml^{-1} while drying reduced the numbers by a further 1.12 $\log_{10}$. Overall there was an increased reduction of 0.5 $\log_{10}$ over the standard process (Fig 1). The effect of temperature on the survival of *E. coli* 0157:H7 in fermented meat is shown in Fig 2. The D value for the "salami" strain decreased from 86.07 min to 1.24 min as the heating temperature was increased from 50 to 60°C. Similar results were recorded for the other two strains investigated.

Discussion: The incidence of *E. coli* 0157:H7 in salami samples (5.37%) was similar to that reported by other workers for ground beef (3.7 %) (Doyle and Schoeni, 1987). However, the presence of the pathogen on salami which is a ready to eat product poses

considerably more risk for the consumer. The standard pepperoni production process reduced the numbers of *E. coli* 0157:H7 by only $\log_{10}$1.47 cfu/g. To ensure safety, a 5 log reduction of the pathogen is recommended (Stentz, 1995). Changing the formulation by lowering the pH to 4.4 and raising the sodium nitrite to 300ppm gave only a 2 log reduction in numbers of *E. coli* 0157:H7 which is still insufficient to ensure safety. An additional heat step at 55 °C for 1h (approximately 3 x D value of 20 min) incorporated into the process between the fermentation and drying stages, in combination with low pH and high sodium nitrite may provide a successful method of achieving the desired 5 log reduction. Further work is necessary to investigate the effect of this heat step and to determine whether the pepperoni remains organolepticaly acceptable following this treatment.

Conclusions: Changes in the stanadard pepperoni production process are necessary to ensure consumer safety. Lowering of pH in association with high sodium nitrite and a mild heat treatment may prove suitable.

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Fig 1. Growth of *E. coli* 0157:H7 in pepperoni under different conditions

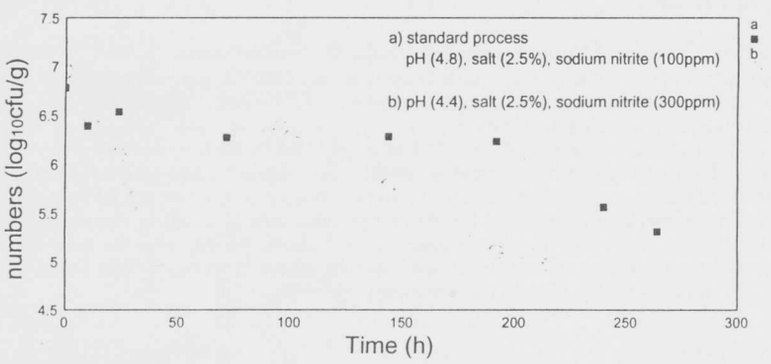

Table1. Incidence of *E. coli* 0157:H7 in fermented meat

product	no.samples	% positive
salami	56	5.35
pepperoni	6	0

Fig 2. D values (mins) for three *E. coli* 0157:H7 strains at three temperatures