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CHLORINATION OF PATHOGENIC *E COLI* O157

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ABSTRACT

Foodborne outbreaks of infectious disease caused by enteropathogenic *E coli* O157 have occurred throughout Japan since 1996. This study was undertaken to check whether commonly used chlorination could effectively inactivate *E coli* O157 in water. Pathogenic *E coli* 157 could be as easily inactivated by chlorine as non-pathogenic *E coli* K12. Although the presence of suspended solids (<5mg/L) reduced the rate of *E coli* inactivation, waters obtained from properly operated treatment systems, including chlorination, would be safe against pathogenic *E coli* O157.

KEYWORDS

Pathogenic *Escherichia coli* O157; *E coli* K12; chlorination; C-T value; turbidity.

INTRODUCTION

Infectious disease outbreaks in 1996 in Japan by enteropathogenic *E coli* O157 caused several persons to die. Although all of the outbreaks were of food origin, it was felt necessary to check the safety of drinking water. Effectiveness of commonly used chlorination for inactivation of *E coli* O157 in water therefore was examined.

MATERIALS AND METHODS

E coli - a pathogenic strain from a patient (identified as serotype O157:H7 capable of producing verotoxin) was used in this study. The pure strain of non-pathogenic *E coli* K12 was selected for comparison with the pathogenic *E coli* for behavior during chlorination. After being grown in nutrient broth, the bacteria were centrifuged and the supernatant removed. The sedimented bacteria were washed twice using phosphate buffer solution to remove chlorine-consuming substances contained in the nutrient medium. Kaolin powder was added to give turbidity.

Disinfection procedure - a bacterial suspension in buffer solution was added to 300mL buffer solution contained in a 500mL glass bottle with a plug. After addition of chlorine, a sample solution was stored in a dark place 30°C. Sodium thiosulphate solution was added to stop the disinfecting reaction at appropriate times and the number of residual bacteria were measured.

RESULTS AND DISUSSION

Both species of *E coli* at concentrations of 100/mL could not be detected 5 min after addition of chlorine at a concentrations of 1mg/L (30°C, pH 7.2). Thereafter the disinfection experiments were done using samples which contained the *E coli* in concentration of around 10^6/mL. The decrease in *E coli* count obtained with initial chlorine concentrations of 0.11mg/L and 0.38mg/L in solutions without turbidity can been seen in Figure 1. It is clear that no differences in chlorine resistance can be seen between *E coli* O157 and K12.

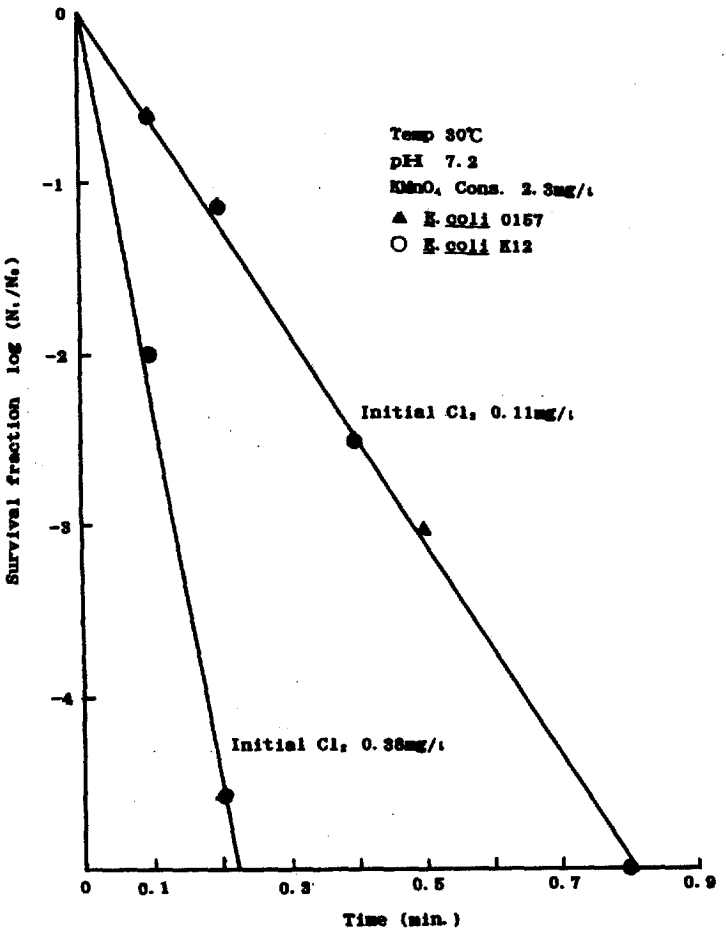

Figure 1. Effect of chlorination on *E coli* without turbidity.

Samples with turbidity of 1mg/L and 5mg/L were chlorinated using initial chlorine concentration of 0.09mg/L and 0.41mg/L. The effect of low turbidity on the reduction of *E coli* was not remarkable. As shown in Figure 2, however, the turbidity of 5mg/L (kaolin) significantly reduced the rate of *E coli* inactivation although there were no differences between the two strains of *E coli*. This study shows that the pathogenic *E coli* O157 has about the same tolerance for chlorine as the non-pathogenic *E coli* K12. This suggests that the pathogenic *E coli* O157 can be easily controlled by the usual and well-operated water treatment systems.

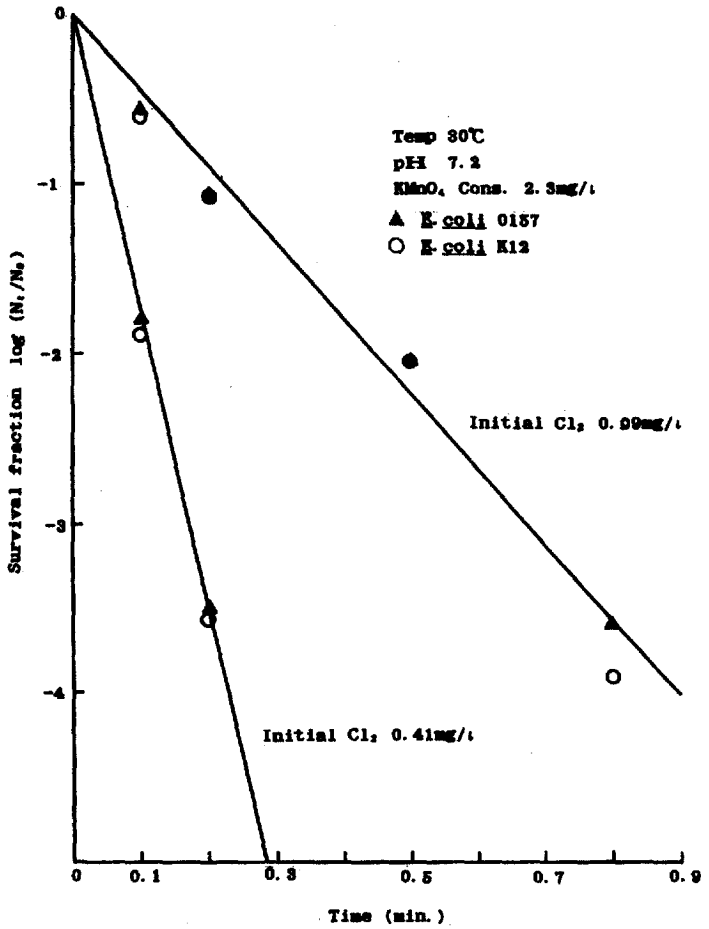

Figure 2. Effect of turbidity (5mg/L) on *E coli* in chlorinated water.

Using data obtained in this study, the C-T values (mg/L.min) for the disinfection of *E coli* O157 were estimated. The residual concentrations of chlorine were applied to the C values. The C-T values for 99% inactivation were 0.032-0.035 in waters without turbidity. Although the turbidity of 1mg/L increased the values slightly, the 99% C-T values in waters of turbidity of 5mg/L were 0.04-0.05. The C-T values for 99.99% inactivation were 0.067-0.071 in waters without turbidity and 0.08-0.09 in waters of turbidity of 5mg/L. These C-T values would be applied to non- pathogenic *E coli* K12 since there were not obvious differences in chlorine resistance between the strains. The C-T values obtained in this study are similar to the values shown by other researchers (Hoff & Akin, 1986; Kawamura *et al*, 1986).

CONCLUSION

The resistance to chlorine of enteropathogenic *E coli* O157 (originating from a Japanese patient) was studied. It is concluded that waters obtained by properly operated treatment systems including commonly used chlorination are safe against *E coli* O157.

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