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# Modeling the decay of *Escherichia coli* in different soils

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## ABSTRACT

Bacteria originating from animal waste are known to contaminate soils and rivers. To better manage animal waste and protect water resources, the survival of fecal bacteria in different soils has to be studied and subsequently models can be developed to estimate the density of fecal bacteria on land at any time after disposal. Even though studies of fecal bacteria decay has been conducted in soils of temperate origin, little is known about the behavior of fecal bacteria in tropical soils. In this study, the decay rate of *Escherichia coli* (*E. coli*) in three different tropical soils from Sarawak, namely, peat soil, clay loam and silt loam, was examined in the laboratory under constant temperature and saturated condition for a duration of 14 days. Results of this study indicated that the mean decay rate of *E. coli* ranged from 0.02 $d^{-1}$ in the clay loam to 0.14 $d^{-1}$ in the peat soil. The low decay rate in clay loam could be due to the higher quantity of clay particles in clay loam soil when compared to silt loam. This study also showed that *E. coli* population remained stable for 3 days in peat soil, 6 days in silt loam and as long as 10 days in clay loam. Even though peat soil has higher organic matter, the decay rate was higher than that of clay loam. This is possibly due to the high acidity of the peat soil. This study indicated that the modified version of the linear first-order decay model which accounted for lag period is an appropriate model in the prediction of *E. coli* decay in all the three soils for the duration studied. Furthermore, there is an indication that the potential of *E. coli* pollution in tropical countries is higher than in temperate countries due to the higher survival rate. Therefore, proper management practice in the application and the disposal of animal waste should be formulated and implemented.

## INTRODUCTION

Microbial contamination of rivers and streams has resulted in unsuitability of river water for drinking and recreational purposes. One of the sources of microbial contaminant is animal waste. Surface application of animal waste for disposal on land or for use as fertilizer is a cheap means of waste disposal (Sims 1995). However, pathogens in the waste are exposed to rain and could be transported to surface water and ground water resulting in contamination as indicated by different studies (Howell et al. 1995; Niemi and Niemi 1991). Animal waste has been associated with diseases. Some pathogenic organisms associated with animal waste are *Salmonella, Cryptosporidium parvum, Mycobacterium, Erysipelothrix, Leptospira, and Clostridium* genera, as well as *Bacillus* (Pell 1997; Ellis and McCalla 1976). In order to better manage animal waste, studies of the persistence of microorganisms in the soil is essential.

Modeling of the decay of bacteria in the environment is a very important aspect in an effort to predict the bacteria population in soil especially on agricultural land. It is a tool that will assist in the management of the waste such as determination of soils suitable for animal waste application with minimal leaching, timing of application and loading without extensive and intensive field activities. According to a review by Crane and Moore (1986), a number of models ranging from simple first order reaction model in chemical kinetics requiring one parameter to complex models requiring six parameters has been proposed to model enteric bacteria decay in the environment. It was reported that the first order decay model was the most common model used in predicting enteric bacteria decay in the environment. There have been reports indicating that the first order model is not suitable when temperature increases and sediment become coarser (Howell et al. 1996).

Fecal bacteria decay in the environment depends on a number of factors such as the organism and its physiological state, the physical and chemical nature of aquatic or soil system, atmospheric conditions,