Influence of Temperature on Escherichia coli Growth Kinetics in Coastal Marine Ecosystems in the Context of Climate Change

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The effect of environmental variation on bacteria in aquatic environments is one of the most discussed topics with significance to public and environmental health. While the relevance of this topic is widely recognized, understanding and monitoring their (activities) is significant in assessing and safeguarding public health. This research assessed the growth rate, generation time, and lag phase of *E. coli* in relation to changing temperatures in coastal regions. The study employed the pathogen modelling program (PMP) to simulate an external model, mimicking similar coastal aquatic environment conditions. Parameters, including water temperature, pH, and salinity, were obtained from reliable online sources specific to each location. Environmental parameters were adjusted in the PMP to maintain nutrients at a level similar to that in the aquatic environment. The calculated values from the model were geographically analyzed according to the representative location. Correlation and regression analyses were performed using GraphPad Prism 8.0.1. The findings reveal that *E. coli* showed varied responses to changes in temperature in different regions, demonstrated by the wide range of growth rates (GR), generation times (GT), and lag phase (LP) duration. The minimum temperature growth rate ranged from 0.014 (Baku) to 0.351 (Baleem, Puerto Escondido) log(cfu/ml/h). At the maximum temperature, GR [log(cfu/ml/h)] varied between 0.119 (Estoril) and 0.520 (Alkhubar). In terms of GT (hours), at minimum temperature, it spanned from 0.86 (Baleem, Puerto Escondido) to 22.18 (Baku) hours, with instances like 0.98, 8.18, and 17.89 hours in Chennai, Melbourne, and Shanghai, respectively. At maximum temperature, the GT ranged from 0.71 (Alkhubar, Miami) to 2.53 (Estoril) hours, including 1.03, 1.08, and 1.80 hours in Barcelona, Durban, and Tunis, respectively. The LP duration at minimum temperature ranged from 8.34 hours in Baleem, Puerto Escondido, to 275.37 hours in Shanghai. At maximum temperature, the LP duration (hours) varied between 6.99 in Alkhubar and 26.73 in Estoril. The top hotspot areas (high GR and short GT) were Alkhubar and Dubai, indicating a high potential for contamination. Furthermore, hotspot areas that suggested greater difficulty in eradication, considering their adaptability to stressful conditions (short LP), were Alkhubar and Dubai. Correlation analysis revealed a strong positive and significant relationship between temperature and GR [$r = 0.997$, $p < 0.001$)], GT [$r = -0.997$, $p < 0.001$), and LP [$r = -0.997$, $p < 0.001$). The linear regression coefficients for temperature with GR (0.0265), GT (-0.1244), and LP (-1.2990) were significant ($p < 0.0001$). The results suggest that temperature plays a crucial role in shaping the GR, GT, and LP of *E. coli*, although the specific mechanisms are not well understood. The findings of this study are essential in understanding the effects of temperature on *E. Coli* in coastal marine environments, which has food safety and public health implications.

Keywords
Climate Change; Escherichia Coli Growth Kinetics; Environmental Stressors; Marine Microbiology; Coastal Aquatic Ecosystem