

Safety, Risk Assessment and Incidence of Escherichia Coli O157 on Fresh Vegetables from
Farms and Markets

by

Onuora, Valentino Chisom

ABSTRACT

This study aimed at evaluating the bacteriological quality and occurrence of Escherichia coli O157:H7 in fresh vegetables from irrigated farms and markets in Nsukka and Enugu metropolises and at estimating human health risks from consumption of such vegetables. Fresh vegetable samples were collected from two farms (STP Farm, irrigated with sewage treatment plant effluent and Mbanefo farm, irrigated with water collected from Hostel drains) and two retail markets (Ogige located in Nsukka and Afia, situated at Enugu). Isolation and identification of presumptive *E. coli* was done using Eosin Methylene Blue (EMB) and Sorbitol MacConkey (SMAC) agar plates and the Gram-staining procedure. The confirmation of *E. coli* and enterohaemorrhagic *E. coli* (EHEC) strain were achieved by polymerase chain reaction (PCR) detection of the target beta-glucuronidase (*uidA*) gene and sequencing of the 16S RNA gene, amplified using universal primers, respectively. Resistance to antibiotics was determined using the Bauer-Kirby disk diffusion method and the Clinical and Laboratory Standard Institute criteria. Quantitative microbial risk assessment (QMRA) was done using the β -Poisson dose-response model. A total of 156 *E. coli* isolates were obtained from a total of 168 vegetable samples (48 samples of each of Amaranth, Fluted pumpkin leaf and Waterleaf, and 24 Garden egg leaf samples) were collected. The microbiological levels of majority of the samples were unsatisfactory (>100 cfu/g). In 161 of the 168 samples (95.8%), >100 colony-forming units (cfu) of *E. coli* per gram were detected. Forty-four of the 156 isolates did not ferment sorbitol, and only seven of these sorbitol-negative isolates were confirmed to be *E. coli* O157:H7, giving a detection rate of 4.2% in vegetables ($n=168$). *E. coli* O157:H7 was detected in all the vegetable types, as well as in farm and market samples, but only during the dry season. The most active antibiotics were carbapenems and fluoroquinolones. Isolates were found to be resistant to a wide range of antibiotics. Multi-drug resistance (MDR) was detected in all the 44 sorbitol-non-fermenting isolates from all sources, ranging from a three-drug resistance observed in two isolates to 16-drug resistance patterns found in three different isolates. Twenty-seven (61.4%) were resistant to 10 or more antibiotics. *E. coli* concentrations were converted to those of enteropathogenic *E. coli* (EPEC). Daily risks of *E. coli* infections from the vegetables, for ingestion exposure during both dry and rainy period, ranged from 5.97×10^{-3} to 2.38×10^{-2} , and was significantly higher during the dry season. The yearly risks of infection were unacceptably high (range: 8.87×10^{-1} to 1), exceeding the acceptable limit of 0.01% ($<10^{-4}$ infection/person/year). The high detection rates for *E. coli* in the vegetables studied

represent a potential public health hazard, heightened by observed multidrug resistance in all the isolates. Washing vegetables properly could be a critical point in food safety and a practical risk management strategy in the study area where the hygienic quality of vegetables proved to be quite bad.