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The role of farming systems and seasonality in the microbiological quality and safety of fresh vegetables sold in Brazil

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The consumption of fresh vegetables is essential for a healthy diet. However, these products are frequently associated with foodborne outbreaks due to contamination with pathogenic microorganisms. Contamination can occur at any stage of the production chain and may be influenced by farming practices as well as environmental conditions. The aim of this study was to report results on the microbiological quality and safety of fresh vegetables sold in Brazil, focusing on the effects of farming systems (conventional [CON] vs. organic [ORG]) and seasonality. A total of 120 samples of fresh vegetables, including lettuce (20 CON and 20 ORG), collard greens (20 CON and 20 ORG), and green peppers (20 CON and 20 ORG), were purchased from supermarkets in the city of Piracicaba, SP - Brazil. Of these, 60 were purchased in November 2023 (spring) and 60 in June 2024 (fall), months with average temperatures of 30 °C and 18.2 °C, and precipitation levels of 132 mm and 39 mm, respectively. These samples were submitted to the enumeration of total coliforms and *Escherichia coli* using the standard most probable number (MPN) method, apart from the detection of *Salmonella* spp. using the ISO 6579-1:2017 method. The mean counts of total coliforms in CON and ORG samples were, respectively: lettuce (3.0 log MPN/g for both), collard greens (3.0 and 3.0±0.1 log MPN/g) and green peppers (2.6±0.8 and 2.9±0.5 log MPN/g). *E. coli* was detected in 65 samples (54.2%), with 34 of these exceeding the current limits established by the Brazilian Surveillance Agency for fresh vegetables. Additionally, its prevalence varied according to the season. In the spring, this prevalence was as follows: lettuce (CON: 9/10; ORG: 10/10), collard greens (CON: 9/10; ORG: 10/10), and green peppers (CON: 5/10; ORG: 10/10). In the fall, this prevalence was: lettuce (CON: 3/10; ORG: 1/10) and collard greens (CON: 3/10; ORG: 4/10), with no samples of green peppers testing positive for this bacterium. In general, green peppers showed slightly lower counts of total coliforms compared to leafy vegetables, regardless of the season and farming system. On the other hand, for *E. coli*, the season influenced both the prevalence and counts of this bacterium in all three types of vegetables, with higher values observed during spring (p=0.00095; Kruskal-Wallis and Willcoxon). Regarding *Salmonella*, three samples (2.5%) tested positive for this pathogen, all of which were lettuce (CON) purchased during spring. Overall, results indicate poor microbiological quality and safety for some samples, due to *E. coli* counts exceeding limits or the presence of *Salmonella*. The farming system had no effect on microbial populations, whereas season had a substantial impact on the results.

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