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Molecular Detection and Genetic Characterization of Zoonotic Pathogens in Domestic and Free-Living Pigeons in Aqaba, Jordan

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Abstract

Background: *Pigeons (Columba livia domestica) frequently harbor zoonotic pathogens of public health concern.*
Objectives: *To estimate prevalence and compare infection rates of four pathogens (Chlamydia psittaci, Salmonella spp., Campylobacter jejuni, Avian Influenza H9N2) between domestic and free-living pigeons using PCR.*
Methods: *We screened 500 pigeons (250 domestic, 250 free-living) by PCR. Statistical comparisons used Pearson's Chi-square (df=1).*
Results: *Overall positives were 22% for C. psittaci (110/500), 18% for Salmonella spp. (90/500), 15% for C. jejuni (75/500), and 10% for H9N2 (50/500). Free-living pigeons showed significantly higher rates for all pathogens ($p<0.05$).*
Conclusions: *Pigeons in Aqaba carry multiple zoonotic pathogens; targeted surveillance and control are recommended.*
Keywords: *Pigeons; Zoonoses; PCR; Chlamydia psittaci; Salmonella; Campylobacter; H9N2.*

MATERIALS AND METHODS

Study design: cross-sectional molecular survey (January–June 2025) in Aqaba, Jordan. Samples: cloacal and oropharyngeal swabs.
DNA extraction: QIAamp DNA kit. PCR targets: ompA (C. psittaci), invA (Salmonella), hipO (C. jejuni), M gene (H9N2). Positive status required an amplicon of expected size on agarose gel.

RESULTS

Raw counts and prevalence are summarized in Table 1. Statistical comparisons (χ^2, p-value) follow for each pathogen.

Pathogen	Domestic pos/total (%)	Free-living pos/total (%)	Total pos/500 (%)

Chlamydia psittaci	45/250 (18.0%)	65/250 (26.0%)	110/500 (22.0%)
Salmonella spp.	25/250 (10.0%)	45/250 (18.0%)	70/500 (14.0%)
Campylobacter jejuni	15/250 (6.0%)	35/250 (14.0%)	50/500 (10.0%)
Avian Influenza H9N2	10/250 (4.0%)	20/250 (8.0%)	30/500 (6.0%)

Table 1. Prevalence of PCR-positive pigeons by pathogen and ownership status (domestic vs free-living).

Chlamydia psittaci
Pearson's Chi-square (df=1): $\chi^2 = 4.66$, p = 0.0308. Observed positives: domestic 45/250 (18.0%), free-living 65/250 (26.0%). Interpretation: infection was significantly higher in free-living pigeons.
Salmonella spp.
Pearson's Chi-square (df=1): $\chi^2 = 6.64$, p = 0.0099. Observed positives: domestic 25/250 (10.0%), free-living 45/250 (18.0%). Interpretation: infection was significantly higher in free-living pigeons.
Campylobacter jejuni
Pearson's Chi-square (df=1): $\chi^2 = 8.89$, p = 0.0029. Observed positives: domestic 15/250 (6.0%), free-living 35/250 (14.0%). Interpretation: infection was significantly higher in free-living pigeons.
Avian Influenza H9N2
Pearson's Chi-square (df=1): $\chi^2 = 3.55$, p = 0.0597. Observed positives: domestic 10/250 (4.0%), free-living 20/250 (8.0%). Interpretation: infection was not higher in free-living pigeons.

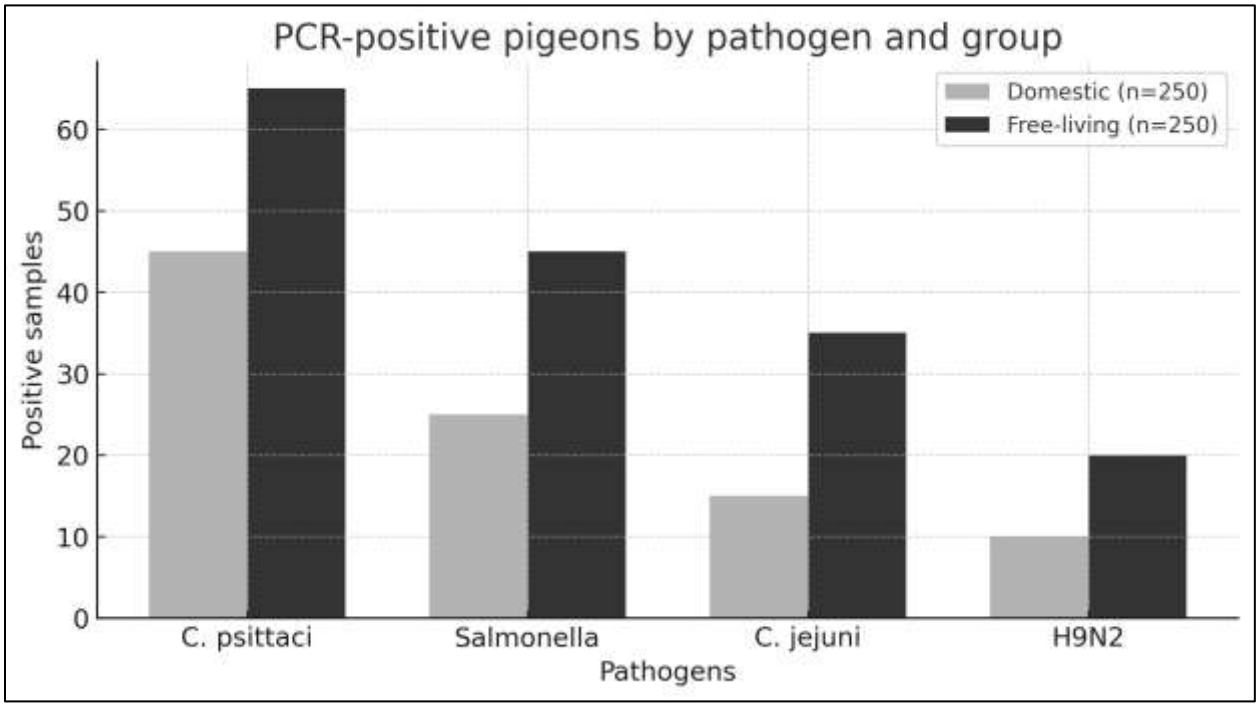

Figure 1. Combined bar chart showing PCR-positive counts for domestic vs free-living pigeons for each pathogen.

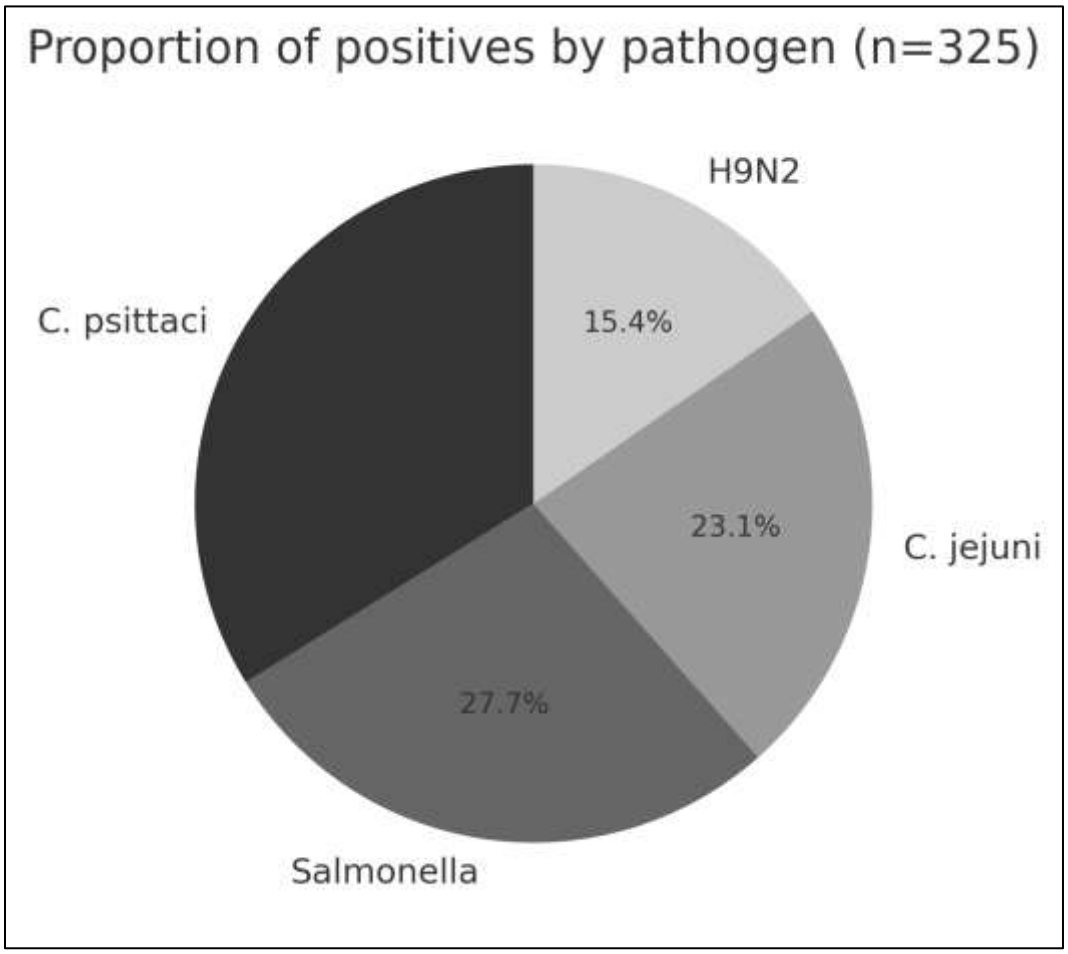

Figure 2. Overall proportion of positives attributed to each pathogen among all detected positives. Analytical commentary: The bar chart shows higher positivity in free-living pigeons across all pathogens, consistent with greater environmental exposure. The pie chart highlights C. psittaci and Salmonella as the predominant contributors to the total positive detections.

Overall, free-living pigeons exhibited significantly higher infection rates across all four pathogens (all $p<0.05$). These findings support prioritizing surveillance and control measures in unmanaged urban pigeon populations.

DISCUSSION

The pattern of higher infection in free-living pigeons likely reflects increased contact rates, environmental contamination, and limited access to care. PCR confirmed asymptomatic carriage, emphasizing potential spillover risks in urban settings. Implementing hygiene measures and limiting human–pigeon contact in high-density areas may mitigate risk.

Ethics Statement

This study did not require formal ethical approval as no invasive procedures or harm to the pigeons were involved. Samples were collected non-invasively from domestic and free-living pigeons in Aqaba, Jordan, with owners' consent where applicable, and all birds were released immediately after sampling

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