



Campylobacter in the United Arab Emirates retail chicken: not-EU, and not-usual

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Outline

- **UAEU**
 - What we do at the Veterinary Public Health Research Lab?
- **Campylobacter situation in retail chicken in UAE:**
 - Broiler meat supply chain
 - Baseline quantitative survey
 - WGS-based characterization:
 - Molecular markers associated with antimicrobial resistance and virulence**





Background

- Joined UAEU in August 2019
 - ❑ Murdoch University, Australia (Lecturer/Senior Lecturer in Vet Pub Health)
 - ❑ Utrecht University, The Netherlands (junior Docent, Vet Pub Health)
 - ❑ Alexandria University (High Institute of Public Health), Egypt (Lecturer in Food Hygiene)
- PhD, Vet Pub Health and Food Safety: Ghent University, Belgium
- Post-doc, Lab of Food Microbiology and Food Preservation: Ghent University, Belgium
- MSc, in Epidemiological Data Analysis: ITM, Belgium
- MSc, in Food Safety and Hygiene Mgt: Birmingham University, UK
- BVSc, Alexandria University: Egypt

College of Agriculture and Veterinary Medicine Department of Veterinary Medicine



The Veterinary Public Health Research Lab @CAVM

Veterinary Public Health Research Laboratory

We work on training the next leaders of Emirati One Health Veterinarians

Serve as a hub for research aiming to resolve national and regional challenges, particularly:

- Microbial Food safety: animal-sourced foods
- Hazard characterization and risk assessment of foodborne pathogens
- Risk profiling of antimicrobial resistance at the human-animal-food interface

Broiler meat supply chain in the UAE:

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Edible Meat Market - Market Size (%), By Meat Type, United Arab Emirate, 2019



- UAE total human population:
 - ~ 10 Millions
- UAE consuming chicken meat:
 - ~ **60 kg/capita per year**
- Local industry:
 - 15% of local market demand (chilled carcasses/ and cuts)
 - 85% of the farms in Abu Dhabi/AI-Ain
 - Slaughter age: ~35 days
- Imported chicken:
 - Global supply:
 - 85% mainly frozen
 - Neighbors supply:
 - Saudi Arabi/ Oman - chilled (shipped overnight)

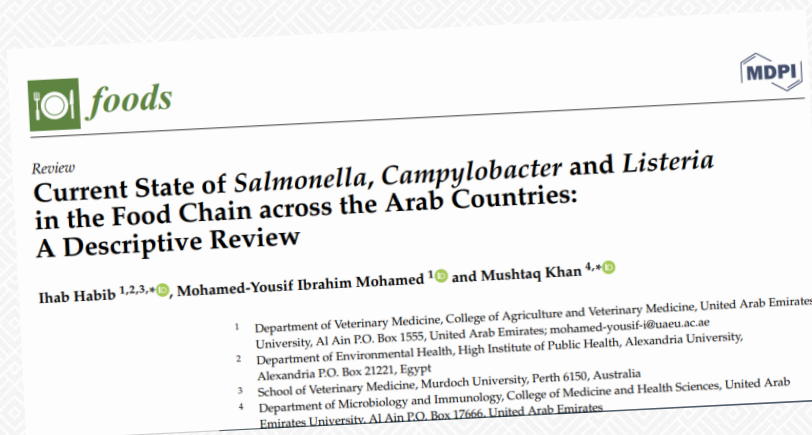
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Broiler meat supply chain in the UAE:

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- There is no published research on the status of *Campylobacter* or *Salmonella* in raw chicken meat presented at retail in the UAE



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- What is the current status of *Campylobacter* as one of the major bacterial hazards impacting the safety of chicken meat presented at UAE retail?
 - The first baseline in UAE (quantitative survey)
- What is the pattern of antimicrobial resistance in *Campylobacter* isolated from chicken meat presented at UAE retail?
 - With molecular epidemiology insight by utilizing whole-genome sequencing (NUS led)
- What is the risk for UAE consumers from consumption of chicken meat contaminated with *Campylobacter*?
 - Consumer-phase: purchase, and handling practices in domestic kitchen
 - Quantitative risk assessment modelling

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- The first UAE baseline on microbial safety of retail chicken meat:
 - Using standard (ISO10272) culture-based method:
 - Tested **315** chilled whole chicken carcasses
 - *Campylobacter* enumeration (=quantitative data, for quantitative risk assessment)
 - » Confirmation: multiplex PCR (up to 5-colonies per a positive sample)
 - Sampled from major supermarkets (n= 26; Al-Ain and Abu Dhabi)
 - Over 10 months (Feb to Nov)
 - Representing 7 brands (=7 businesses)
 - » 6 UAE companies + 1 Saudi company
 - » Representing more than 85% of fresh (chilled) supply in UAE
 - Selection of isolates (n= 45)
 - Antimicrobial resistance (MIC): EUCAMP2 plates (Thermo Scientific)
 - WGS: Illumina (send-out service, NOVOGENE in UK)

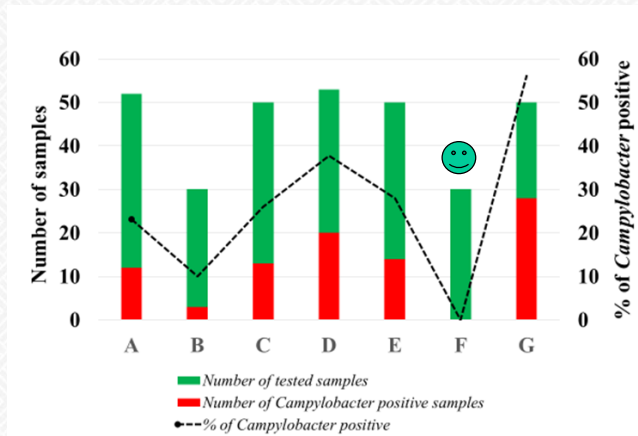


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1) Overall detection across the 7 brands:

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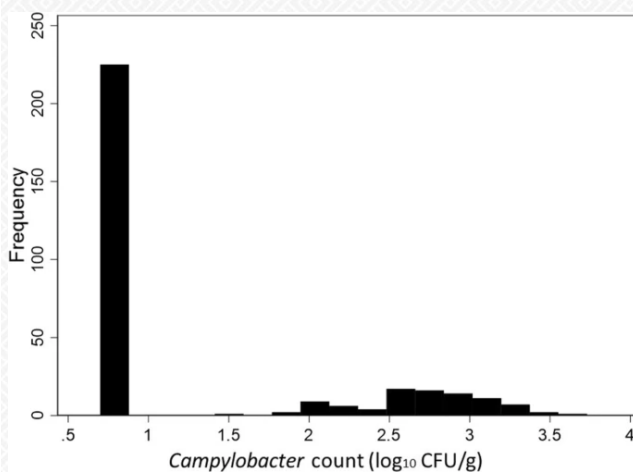
- *Campylobacter* isolates were recovered from **28.6%** [90/315] (95% confidence interval: 23.6%;33.9%) of the tested retail whole chicken carcasses in UAE.

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2) Quantification: *the devil in the (de)tails*

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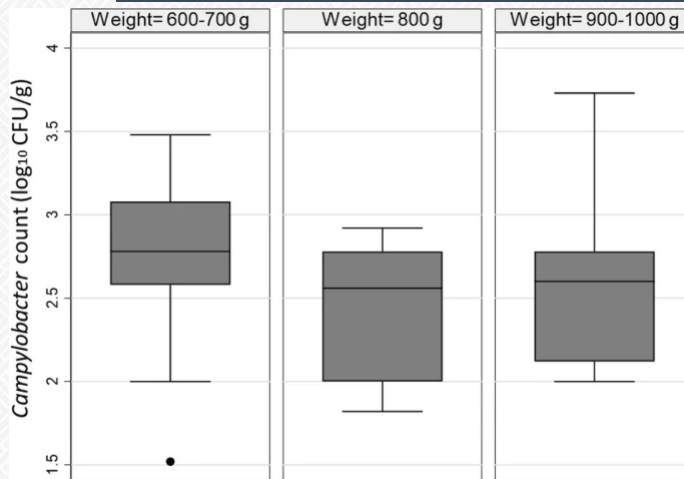


- **71.4%** of the samples $< 1 \log_{10}$ CFU
- **7%** of the samples with $\geq 3 \log_{10}$ CFU/g
- Average *Campylobacter* concentration: **2.70 \log_{10} CFU/g** (SD of 0.41 \log_{10} CFU/g).

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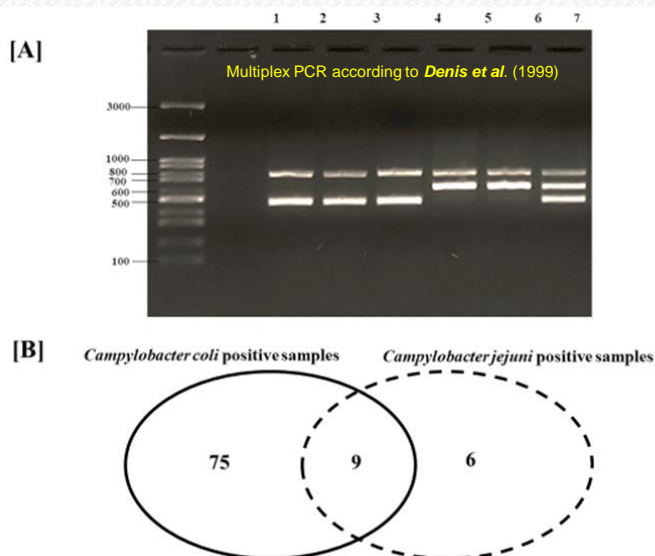
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3) What is the unusual? *Size (chicken weight) matters*



Significantly higher (p -value < 0.0001) *Campylobacter* counts were found to be **associated with smaller size chicken carcasses** (weighted 600–700 g; compared to the other categories, 800 g and 900–1000 g)

4) What is the unusual? *the dominance of Campylobacter coli*



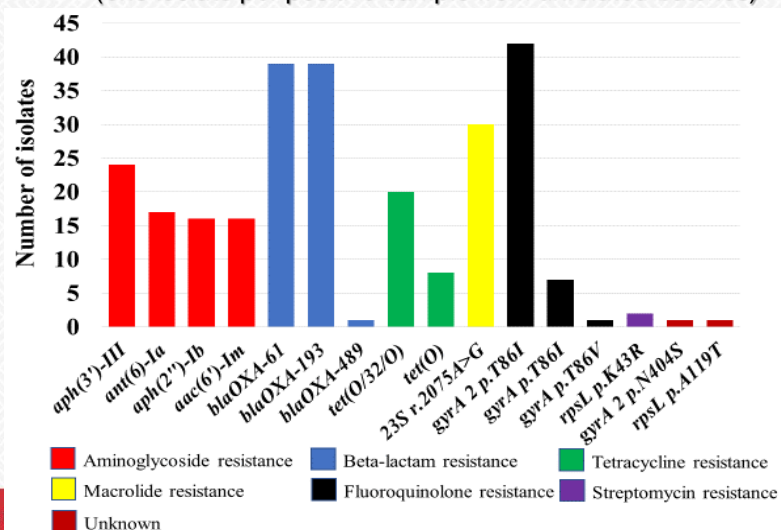
- *Campylobacter* was detected in 90 (28.6%) out of 315 tested samples:
 - Up to five isolate isolates from each were confirmed using multiplex PCR.
 - **Solely, the species *C. coli* was present in 83% (75/90) of the positive samples.**

5) Whole-genome insight:

AMR resistance genes and point mutations

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45 non-redundant *C. coli* isolates was characterized further by WGS (one isolate per positive sample from unrelated batches)



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6) Whole-genome insight:

Concordance between resistance genotype and phenotype

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Classes of antimicrobials	Antimicrobials*	ECOFF**	No. of phenotypically resistant isolates (out of 45 <i>C. coli</i>)	AMR genes and mutations	Concordance between genotype and phenotype
(Fluoro)quinolone	NAL (but not CIP)	> 16 µg/ml	1	<i>gyrA 2 p.T86I</i> (n = 1)	
	CIP (but not NAL)	> 0.5 µg/ml	1	<i>gyrA 2 p.T86I</i> + <i>gyrA p.T86V</i> (n = 1)	100% (42/42)
	CIP+NAL		40	<i>gyrA 2 p.T86I</i> (n = 33); <i>gyrA 2 p.T86I</i> + <i>gyrA p.T86I</i> (n = 7)	
Macrolide	ERY	> 4 µg/ml	30	<i>23S r.2075A>G</i> (n = 30)	100% (30/30)
Aminoglycoside	GEN	> 2 µg/ml	17	<i>aph(2'')-Ib</i> + <i>aph(3')-III</i> , + <i>aac(6')-Im</i> (n = 9); <i>aph(3')-III</i> (n = 7)	94.1% (16/17)
Aminoglycoside	STR	> 4 µg/ml	18	<i>ant(6)-Ia</i> (n = 5); <i>ant(6)-Ia</i> + <i>rpsL p.K43R</i> (n = 2); <i>ant(6)-Ia</i> + <i>aph(3')-III</i> (n = 3); <i>aph(2'')-Ib</i> + <i>aph(3')-III</i> + <i>aac(6')-Im</i> + <i>ant(6)-Ia</i> (n = 7)	94.4% (17/18)
Tetracycline	TET	> 1 µg/ml	29	<i>tet(O)</i> (n = 8); <i>tet(O/32/O)</i> (n = 20)	96.5% (28/29)

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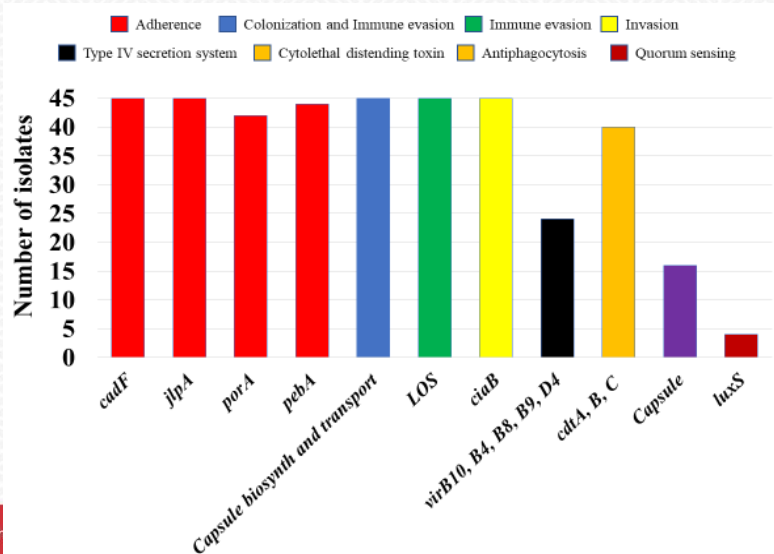
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6) Whole-genome insight:

in silico predicted virulence factors

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WGS revealed between **7** to **11** virulence factors per each *C. coli* isolate



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Summary

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- The first-of-its-kind data on contamination levels of *Campylobacter* in the UAE retailed chilled chicken carcasses.
 - Compared with studies from other countries utilizing the same enumeration method, the UAE chicken appears to have **a lower prevalence but a higher *Campylobacter* count/ gram.**
 - Higher *Campylobacter* counts were associated more with smaller carcasses.
 - *C. coli* was the dominant species detected in this study's samples.
 - impact on public health??!!!!
 - The prevalent *C. coli* in the UAE retail chicken:
 - Carries many virulence and antimicrobial resistance markers
 - Exhibits frequent phenotypic resistance to macrolides, quinolones, and tetracyclines.
 - + the molecular epidemiology of non-jejuni *Campylobacter* species in the Middle East and globally.

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Further work:

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**THE
BIG
PICTURE**



In addition to ***Campylobacter***

All samples (= 315) are also screened for:
Non-typhoidal *Salmonella*
and, ESBL *E. coli*

Sub-samples (= 165) are also screened for:
***Enterococcus* (screened for AMR)**

THE EXTRA MILE

Evidence-base towards a better understanding of microbial safety
of chicken meat in one of the biggest consumption markets worldwide, the UAE

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The Team:

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UAEU- VPHR Lab

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RESEARCH

Open Access

Quantification of *Campylobacter* contamination on chicken carcasses sold in retail markets in the United Arab Emirates



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