ENTERIC VIRUSES IN WATER AS A RISK FACTOR IN A MEGACITY

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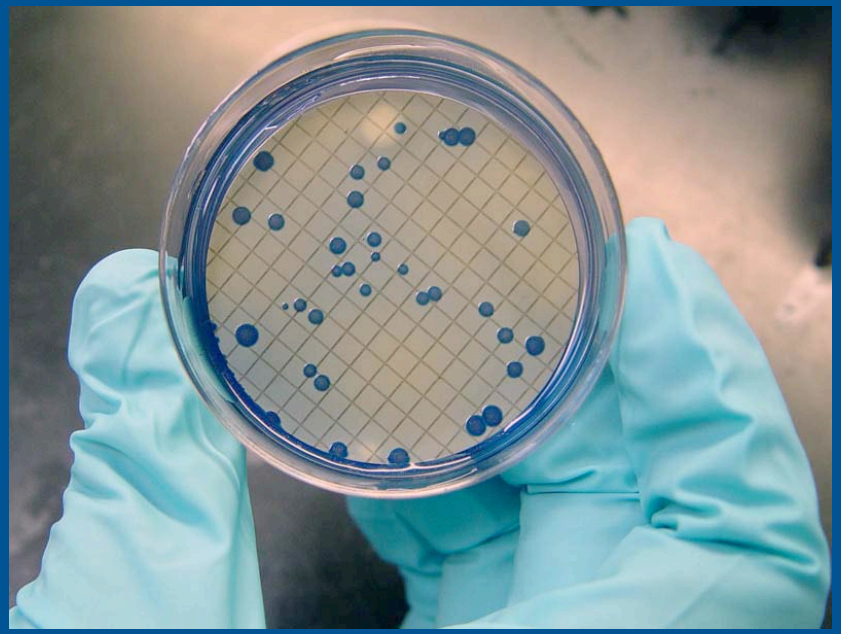
Background

94% of all diarrhea cases attributable to the environment

88% associated with risk factors →contaminated drinking water/poor sanitation (WHO, 2006)



Coliform bacteria→ most common indicator fecal water contamination

Bacterial indicators do not correlate number and viability of enteric viruses

Viruses > resistant than bacteria environmental factors and water treatment

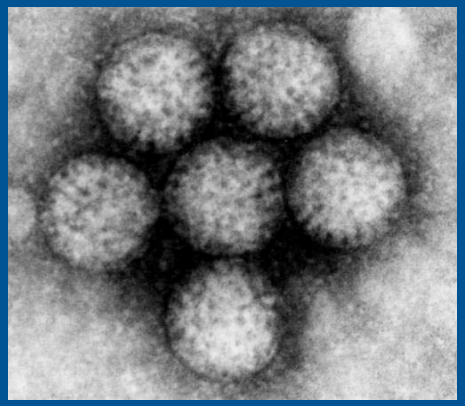
Infective doses of viruses < than bacteria

Developing countries→ epidemic information incidence of viral gastroenteritis unknown, incomplete or not updated

Table 1. Infective doses of different pathogen groups

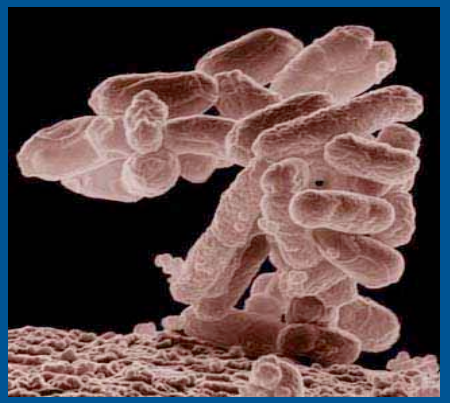
Pathogen	Infective dose
Enteric viruses	1 PFU
Protozoa	25-100 cysts/oocystes
Fecal bacteria	>100 CFU

Alonso *et al*, 2006.



Rotavirus

Giardia intestinalis (cyst)



Escherichia coli

Mexico City Metropolitan Area (MEGACITY)

> 22 million inhabitants

High water demand drinking and others uses

Wastewater production (68 m^3/s)

Defficient/inadequate wastewater treatment (<10%)

Concern about drinking water quality

Inadequate reuse of treated wastewater for irrigation purposes

Specific case study

→Universidad Nacional Autónoma de México (UNAM)

PUMAGUA

Multidisciplinary program→ managment, use, reuse of water, conduced at UNAM

Main goals

✓ Safe drinking water for university community, representative area South of Mexico City

✓ Promote safe reuse of treated wastewater

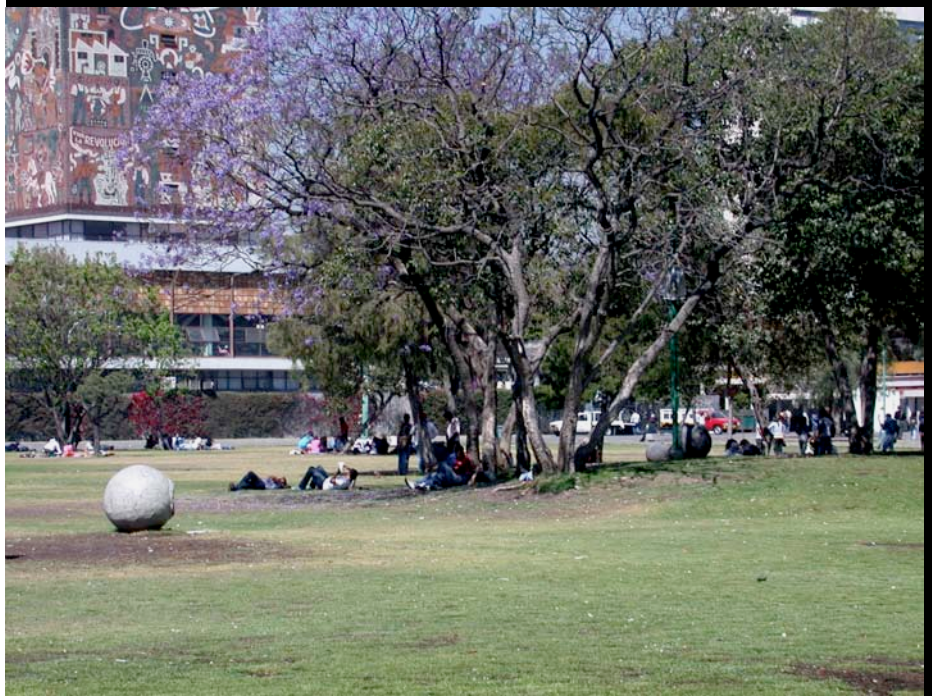
Cycle 2009: cold-dry, warm-dry and rainy season

Presence and quantity of indicator bacteria, enterovirus, adenovirus, coliphage in groundwater, wastewater, and treated wastewater reused for recreational areas irrigation

Groundwater

Reuse treated wastewater

UNAM wastewater treatment plant



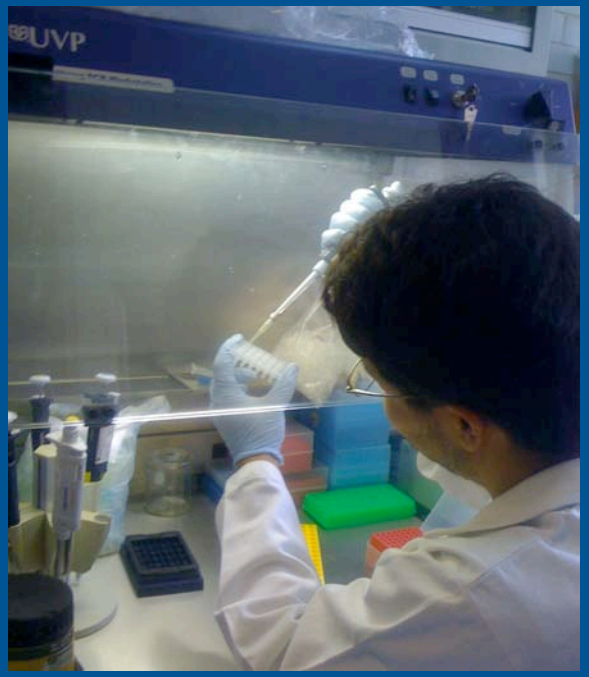
Sample concentration by ultrafiltration (polysulphone hollow fibers)

Membrane filtration for fecal coliform (FC) and fecal enterococcus (FE) quantification in m-FC and KF media

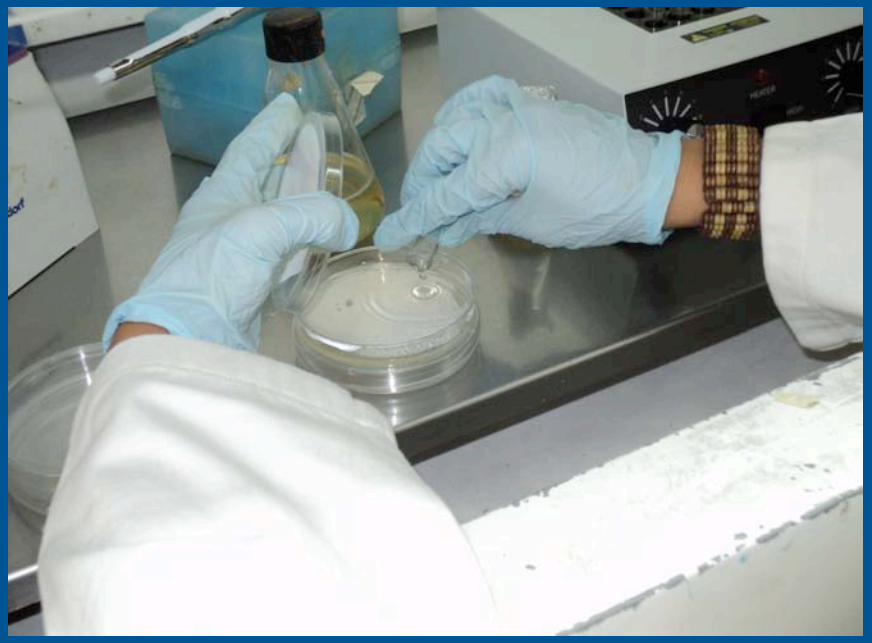
qPCR for enterovirus (EV) and adenovirus (AdV) genome quantification

✓EV conserved region for enterovirus 5'NTR

✓AdV conserved region for AdV 40 and 41, L4 region

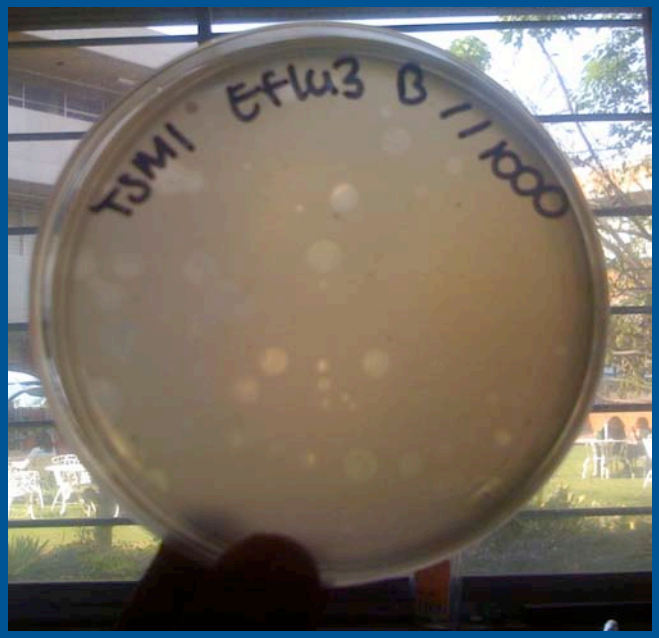


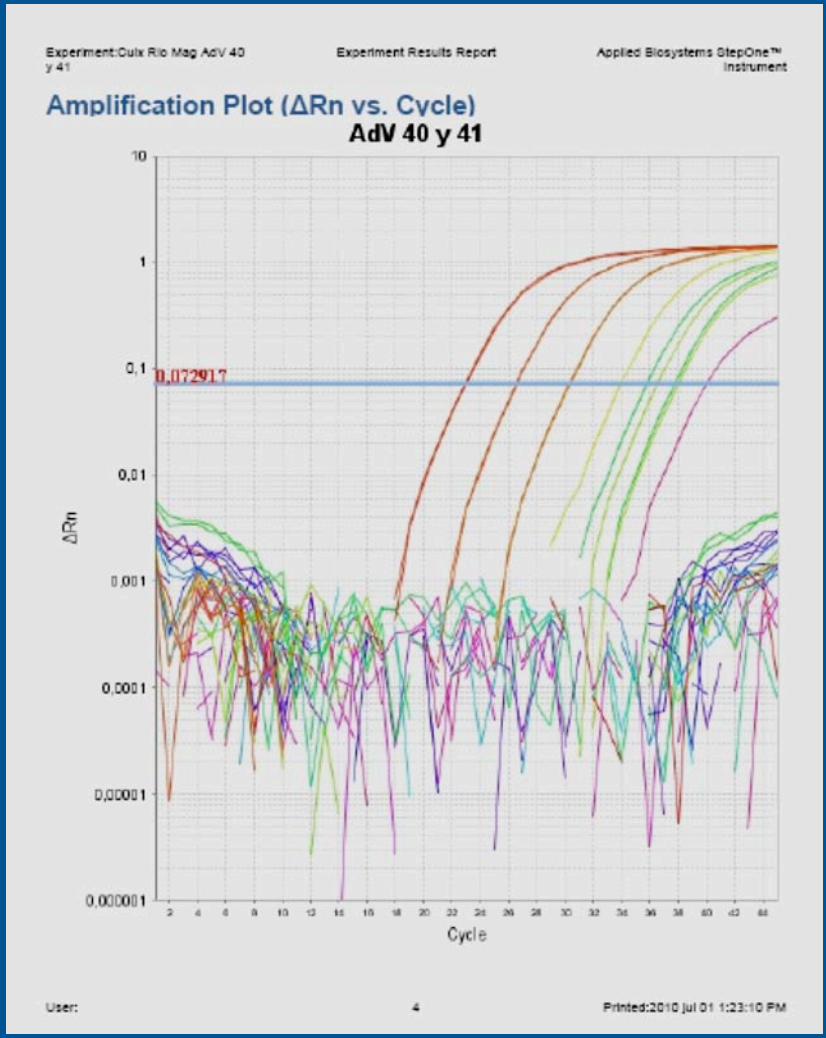
Double agar layer for coliphage F-RNA specific quantification using *Escherichia coli* K12 host bacteria



Results

Wastewater showed highest counts for all indicators: FC, FE, EV, AdV and coliphage





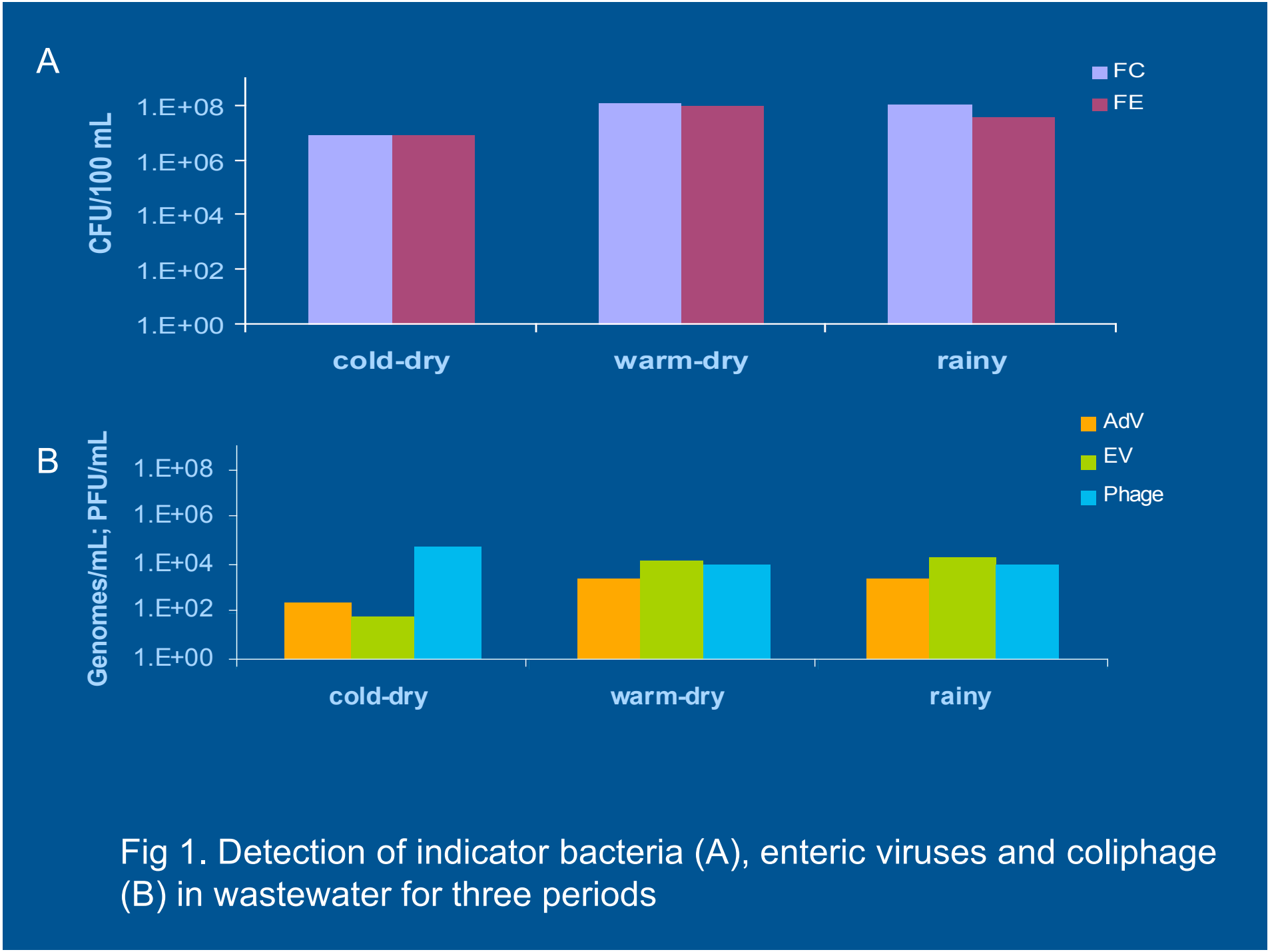


Fig 1. Detection of indicator bacteria (A), enteric viruses and coliphage (B) in wastewater for three periods

FC and FE not detected in treated wastewater→ adequate bacteria remotion. Enteric viruses and coliphage detected

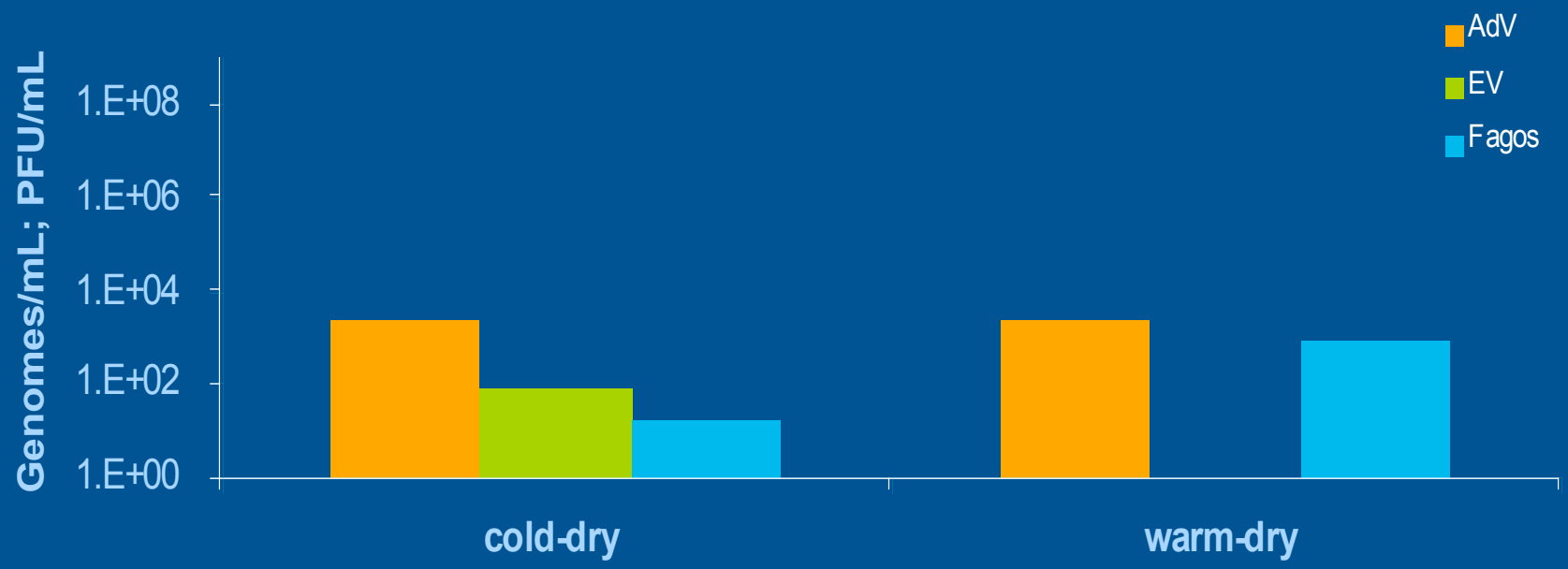


Fig 2. Enteric virus (EV, AdV) and coliphage in treated wastewater for two periods (wastewater not treated in rainy season).

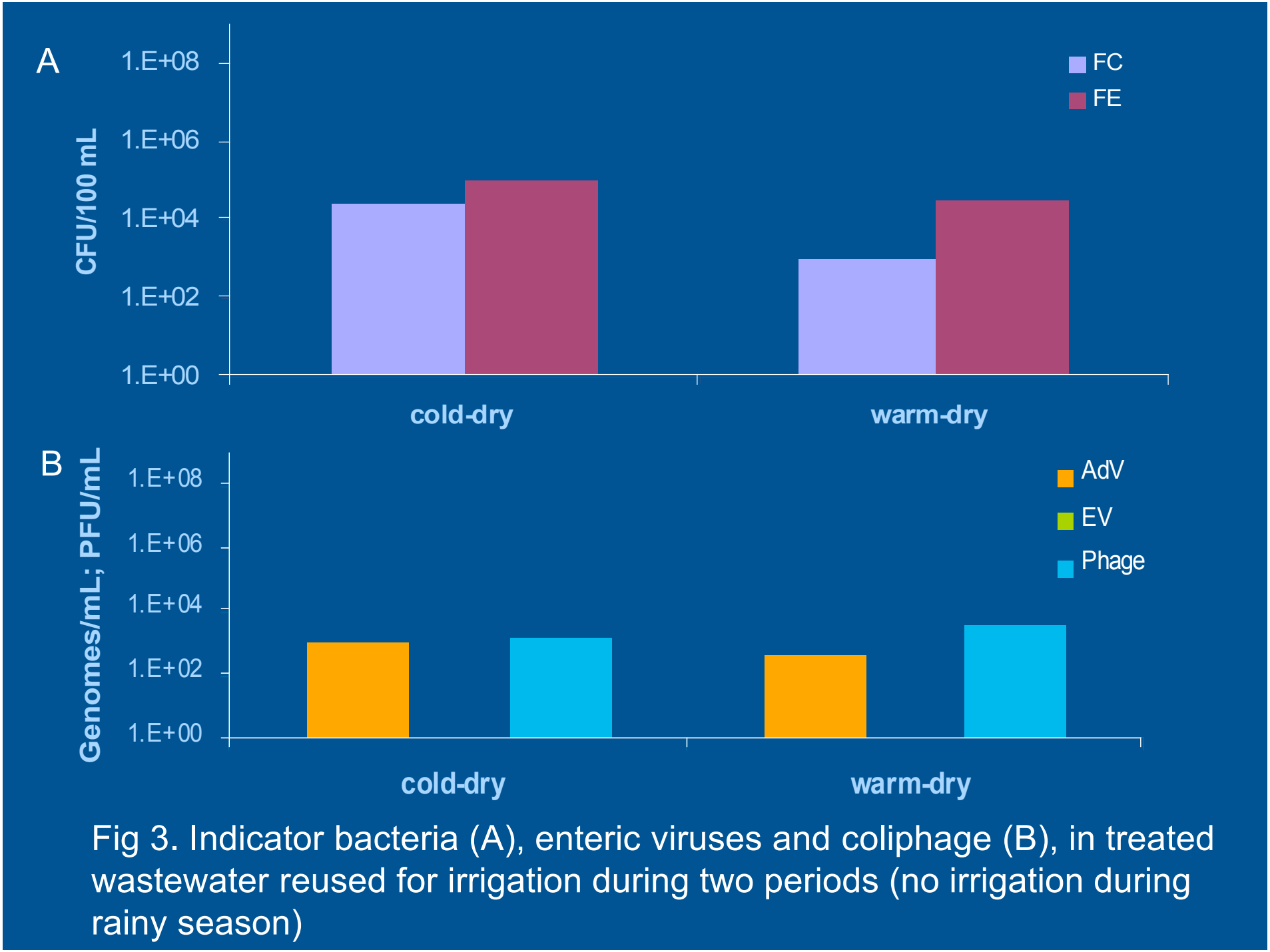


Fig 3. Indicator bacteria (A), enteric viruses and coliphage (B), in treated wastewater reused for irrigation during two periods (no irrigation during rainy season)

Table 2. Indicator bacteria (CFU/100 mL), enteric viruses (genomes/mL), coliphage (PFU/mL) in groundwater for three periods (2009)

Period	Indicator				
	FC	FE	AdV	EV	Coliphages
cold-dry	1	1	31	2	<1
warm-dry	<1	<1	<1	<1	23
rainy	<1	1	<1	<1	20

Conclusions

Although wastewater treatment achieved to remove FC and FE, reused water for irrigation showed bacterial re-growth or re-contamination

FC, FE counts and enteric virus in reused water for irrigation → hazards to the University community exposed in green areas

Based on microbial indicators→groundwater from University campus+disinfection adequate source for drinking water

Monitoring enteric viruses in urban wastewater and reused water → necessary and useful as a risk assessment tool for the exposed population

Water managment must consider risk assessment studies in order to take better decisions to avoid or decrease health impacts

Acknowledgments

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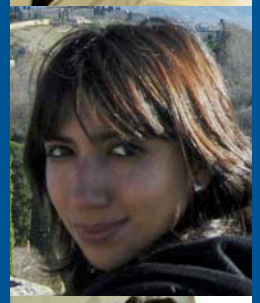

Gamsahamnida