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Accumulation of Faecal Indicator Bacteria in River Biofilms

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Aim of the study

- Surface waters are contaminated with faecally derived bacteria from sewage effluents and agricultural run-off.
- ***Escherichia coli* and intestinal enterococci** serve as microbiological parameters indicating **faecal pollution** and the possible presence of pathogenic organisms.
- **Total coliforms**, wich are either of faecal or environmental origin, provide **basic information on surface water quality**.
- **Can these bacteria accumulate in river biofilms, indicating their function as potential reservoirs for pathogens of faecal origin?**

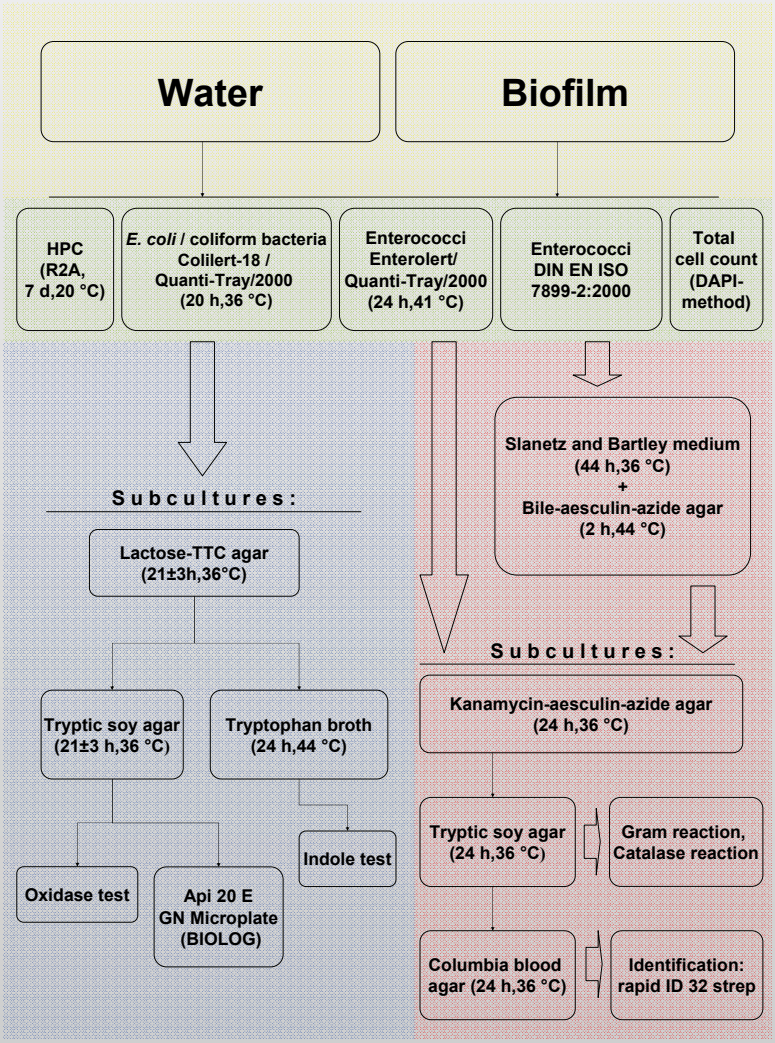
Conclusions

- **Faecal indicator bacteria accumulate in river biofilms at levels approximately one to three log units higher than in the bulk water phase.**
- **Biofilms in polluted surface waters may be reservoirs for pathogenic microorganisms and contribute to the deterioration of water quality by releasing faecally derived pathogens.**
- **Such processes have to be considered in risk assessments for surface waters which are used as source water for drinking water production or for recreational purposes.**

Methods

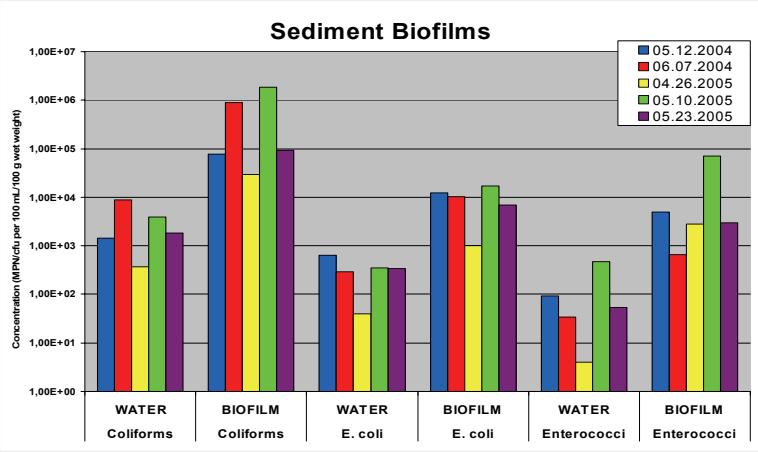
- **Ten samplings of water and biofilms were performed at different sites of surface waters:**
  - River Ruhr (Mülheim a. d. Ruhr)
  - Moersbach (Moers)
  - Anrathskanal (Moers)

- **Sample collection:**
  - River water, epilithic biofilms and sediment biofilms
- **Detatchment and dispersal of biofilms:**
  - 10 g wet weight of epilithic biofilms were dispersed in 90 ml water for 20 min by Stomacher treatment.
  - 10 g wet weight of sediment biofilms were dispersed in 90 ml water for 10 - 20 min with by sonication in an ultrasonic bath.
- **Microbiological analysis:**



Results

- **Levels of all microbiological parameters were always higher in biofilms then in the water phase.**
  - Total cell counts (TCC) of water varied between $1x10^6$ and $1x10^7$ cells/ml.
  - Biofilms displayed cell counts between $2x10^9$ and $5x10^{10}$ cells/ml.
- HPC percentages of TCC were 0.2 to 17 % in water and 0.04 to 8.2 % in biofilms.
- ***E. coli* and enterococci were detected in all water and biofilm samples.**
  - The concentration of *E. coli* ranged from $4x10^1$ to $1x10^3$ MPN/100ml in water and from $1x10^3$ to $2x10^5$ MPN/100g wet weight in biofilms.
  - Enterococci varied between $4x10^0$ and $5x10^2$ cfu/100ml in water and $3x10^3$ to $3X10^5$ CFU/100g wet weight in biofilms.
- **Both types of biofilms (epilithic, sediment) showed no significant difference in all microbiological parameters.**



Figures: Concentrations of coliforms, *E. coli* and enterococci in epilithic and sediment biofilms; colour corresponds to sampling date

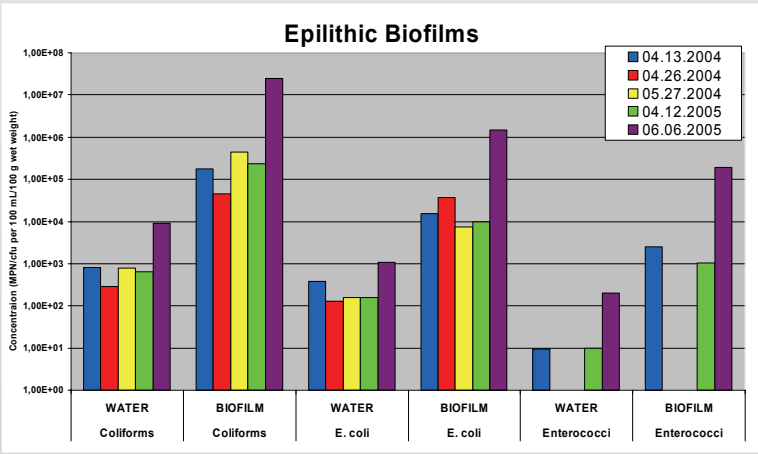


Table: Diversity of coliform and enterococcal species in biofilms.
In brackets: number of species identification/number of investigated biofilms; underlined: intestinal enterococci

Coliforms		Enterococci
Buttiauxella agrestis (1/5)	***Escherichia coli* (5/5)**	*E. casseliflavus* (2/4)
Citrobacter braakii (3/5)	*Klebsiella oxytoca* (2/5)	*E. casseliflavus / gallinarum* (3/4)
Citrobacter freundii (3/5)	*Klebsiella pneumoniae* (3/5)	*E. durans* (1/5)
Citrobacter koseri/farmeri (1/5)	*Kluyvera spp.* (1/5)	*E. faecium* (2/4)
Citrobacter youngae (2/5)	*Pantoea spp.* (3/5)	*E. faecalis* (3/4)
Enterobacter aerogenes (1/5)	*Rahnella aquatilis* (1/5)	*E. faecium / gallinarum* (2/4)
Enterobacter amnigenus (1/5)	*Serratia liquefaciens* (2/5)	*E. gallinarum* (2/4)
Enterobacter asburiae (1/5)	*Serratia fonticola* (2/5)	*E. gallinarum / casseliflavus / faecium* (2/4)
Enterobacter cloacae (1/5)	*Serratia marcescens* (2/5)	*E. gallinarum / hirae* (1/4)
Enterobacter intermedius (1/5)	*Serratia rubidea* (1/5)	*E. hirae* (1/4)
Enterobacter nimipressuralis (1/5)	*Yersinia enterocolitica* (1/5)	*E. hirae / durans* (1/4)
	Yersinia mollaretii (1/5)	