Fleas, vector of *Yersinia pestis*, pathogen of Plague

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An historical Relationship

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An important biodiversity (1)

- 15-16 Families
- 239 Genus
- >2500 described species

- Worldwide distribution, including Antarctica

- Vectors of pathogens of Plague, Murine Rickettsia, Typhus,...
An important biodiversity (2)

Xenopsylla cheopis

Xenopsylla brasiliensis

Pulex irritans

Ctenocephalides felis

Tunga penetrans

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Basics of Flea Biology

- Holometabolous (4 phases)
- 3 larval instars
- Legless larvae
- Parasite Adult: Obligatory hematophagous
- Insect without wings, without tail
- Prehensile claws + hind legs adapted for jumping
- 94% mammals’ parasite (5% birds)
- Size: 1-6 mm (jump: 320 mm)
Flea and Diseases

Rat fleas
Xenopsylla cheopis
Xenopsylla brasiliensis
Synopsyllus fonquerniei

Dog fleas & cat fleas
Ctenocephalides sp.

Human fleas
Pulex irritans

Chigoe fleas
Tunga penetrans

Bubonic plague
(Yersinia pestis)

Murine typhus
(Rickettsia typhi)

Tungose
(Tunga penetrans)

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Biological cycle of fleas

Egg-laying → Eggs

Emergence → Adult (imago)

Pupation → Pupae

4 instar larvae → 3 moultning

Hatching → Eggs

Blood feeding on hosts

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A Middle Age perception

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Plague Cycle

Selvatic cycle
Wild rodents

Bubonic plague

Urban cycle
« Domestic » rodents

Can evolve

Secondary Pulmonary Plague

Pulmonary plague
Outbreak

Propagation ways
normal
occasional
rare or hypothetical

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**Yersinia pestis Transmission**

**Blocked fleas**
- *Y. pestis* multiplication → blocking of proventricules
- Infected fleas increase blood meal frequency
- Dead of fleas 5 days after blocking (limited transmission)

**Non-blocked fleas**
- Early Phase Transmission – **EPT**
- EPT 1-4 days post-infection

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Host-vector association

- Wide host spectra, non specific
- One flea species on several hosts
- One host with several flea species
- Environmental effect
- Climatic variations effects
- Fleas’ transfert between host in one biotope