The intestinal microbiota of tephritid fruit flies as a potential tool to improve rearing and the SIT

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Outline

1. Tephritid - bacteria associations

2. Bacteria and adult fruit fly fitness:
   The olive fly as an example

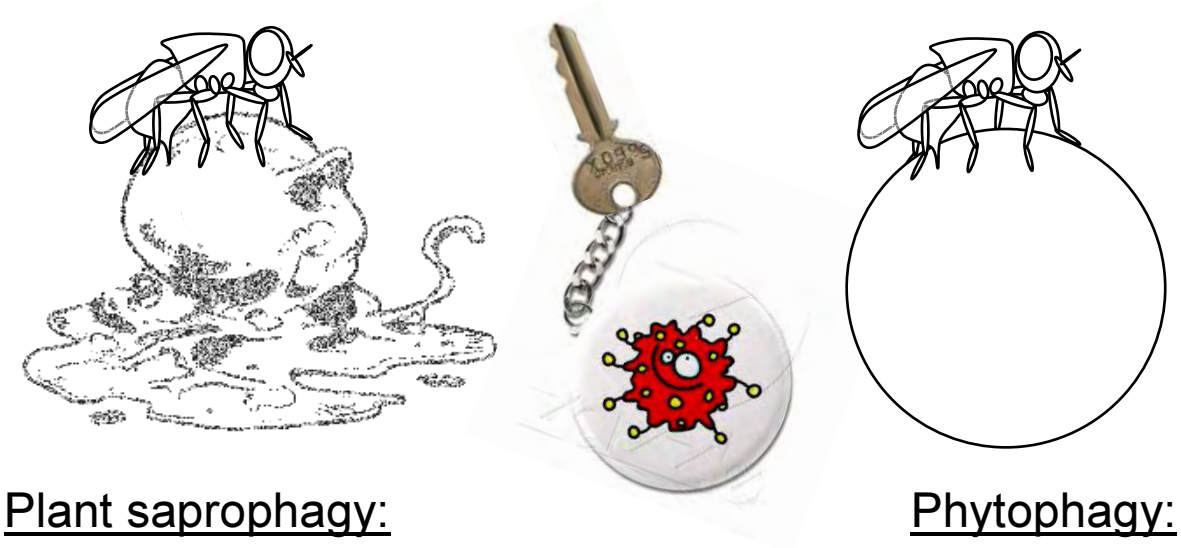
3. Bacteria and the Sterile Insect Technique:
   The Medfly as a case study

4. Final conclusions

Evolution of Tephritid – bacteria associations

Superfamily Tephritoidae → Family Tephritidae

General saprophagy → Plant saprophagy → Phytophagy



Plant saprophagy:

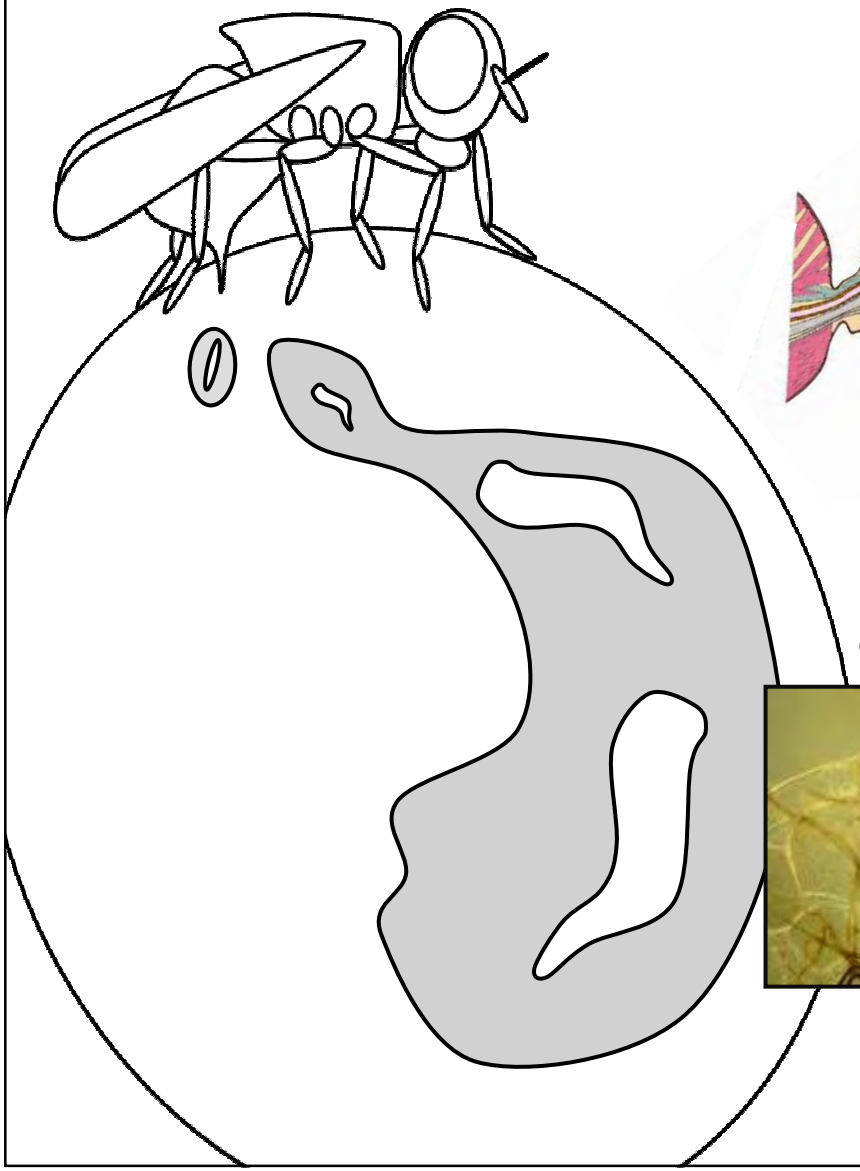
Self-rotting vegetation

Phytophagy:

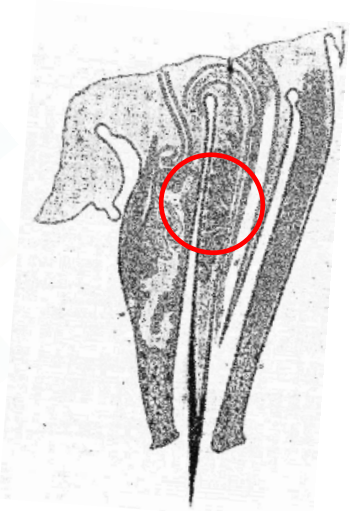
Fly mediated rot in living plant tissues

Diaz-Fleischer et al. 2000

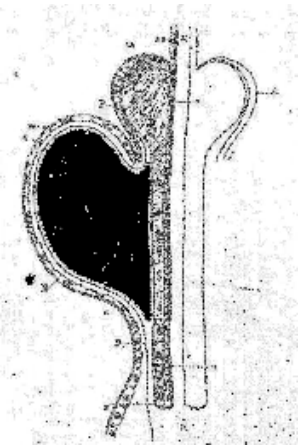
Olive fly-bacteria association



Capuzzo *et al.* 2005



Petri 1910



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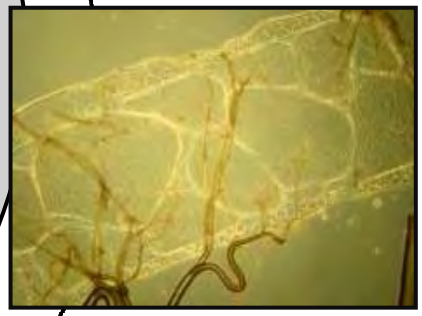
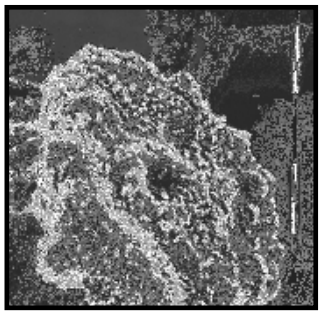




Effect of bacteria on olive fly fitness

Adult flies feed opportunistically but mainly on honeydew

Examining the effect of bacteria and diet on female fecundity

Mated wild females:

Sucrose

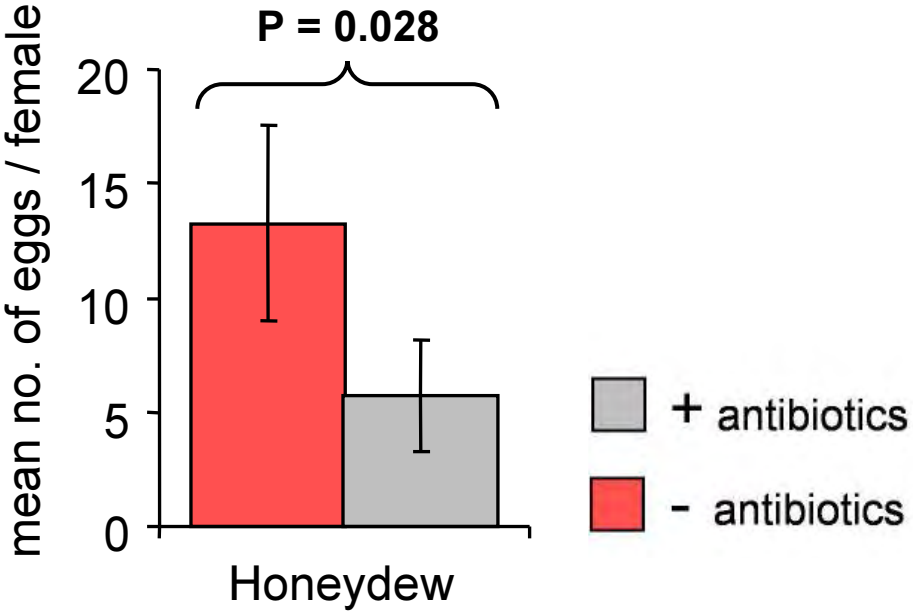
Sucrose + non-essential amino-acids

Full diet (sucrose + Yeast hydrolysate)

+ / - Antibiotics

Ben-Yosef *et al.*, *Proc. R. Soc. B,* 2010

Effect of bacteria on olive fly fitness

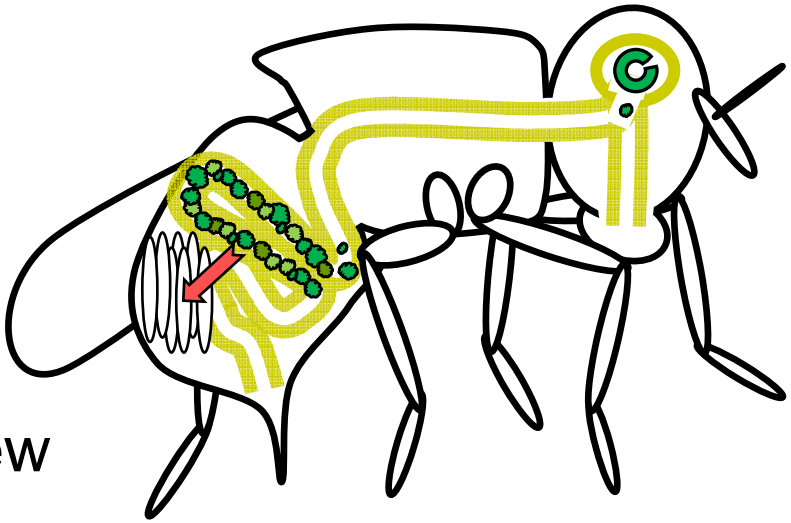


- Bacterial contribution to fecundity is diet dependent.
- Bacteria are needed only when females feed on an unbalanced amino-acid diet

Ben-Yosef *et al.*, *Proc. R. Soc. B,* 2010

Bacteria and adult fruit fly fitness: conclusions

intestinal bacteria contribute amino-acids or protein to the fly



Allows flies to subsist on low quality food such as honeydew

Other fruit flies may similarly depend on their intestinal bacteria

(Dacus, Ceratitis, Rhagoletis, Anastrepha)

Disruption of symbiotic relationships during mass rearing

- Egg disinfection
- Diet Acidification
- Use of antibiotics and preservatives

- Irradiation of pupae

The irradiation affects the gut microbiota

Reduced mating competence of sterile Medfly males

Irradiation effect on medfly gut microbiota

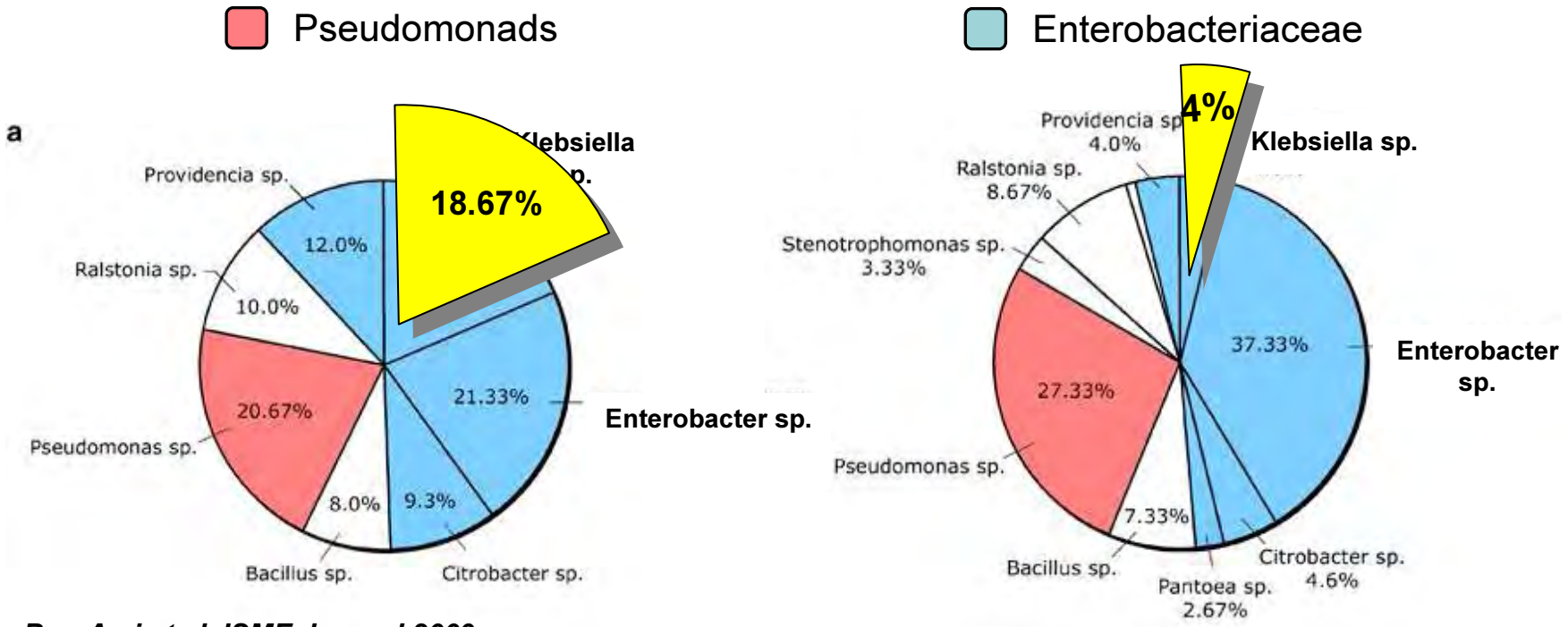
V8 (Day 1)

Sterile V8 (Day 1)

Sterile V8 (Day 5)

Wild (Day 1)

1. Gut bacterial community profiling by Amplified rDNA restriction analysis (ARDRA)



Ben-Ami et al. ISME Journal 2009

Irradiation effect on medfly gut microbiota

V8 (Day 1)

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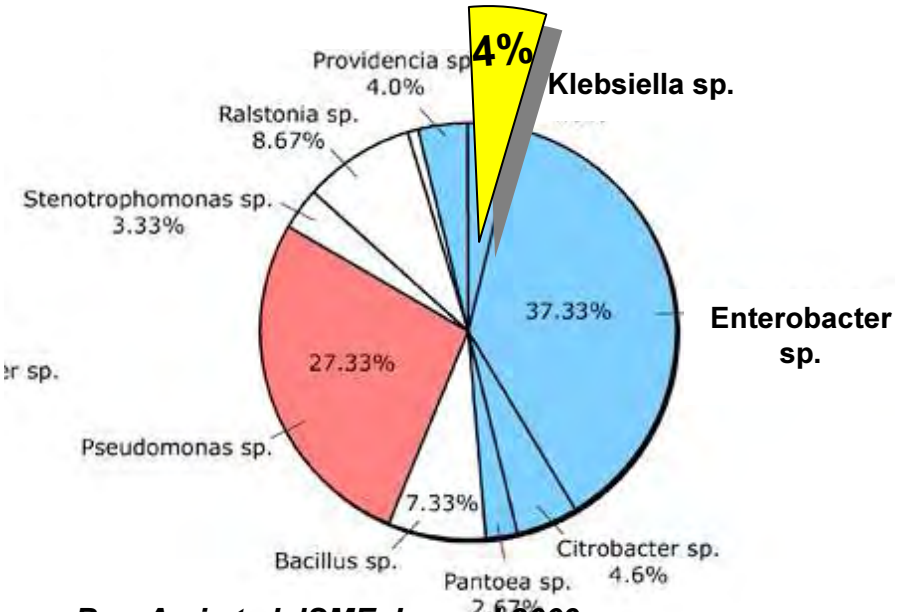
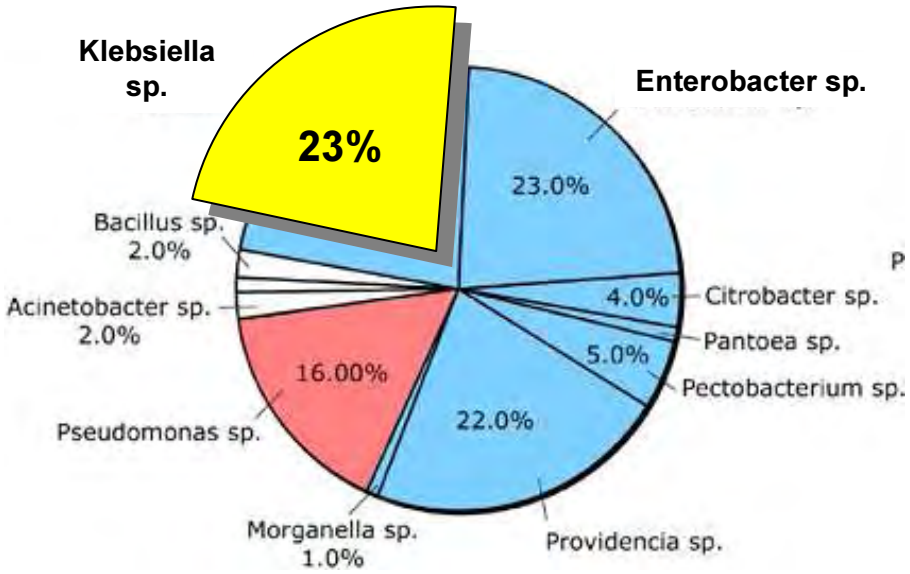
Pseudomonads

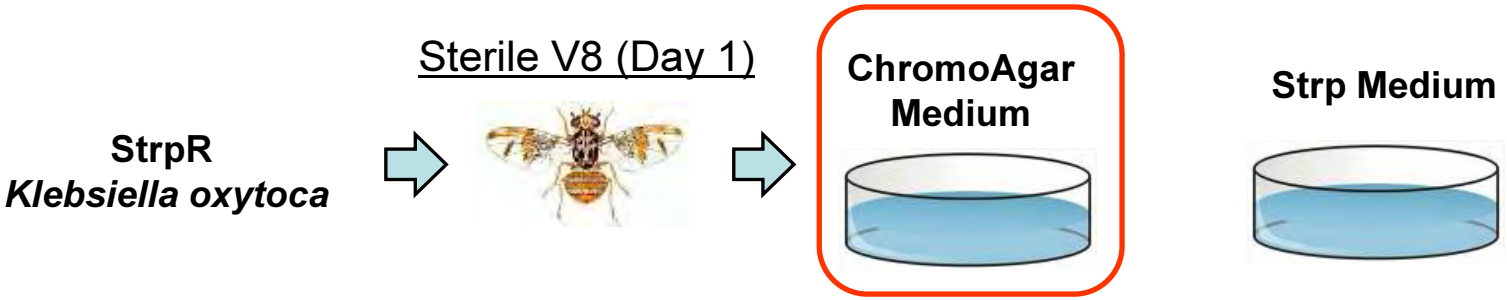


Enterobacteriaceae

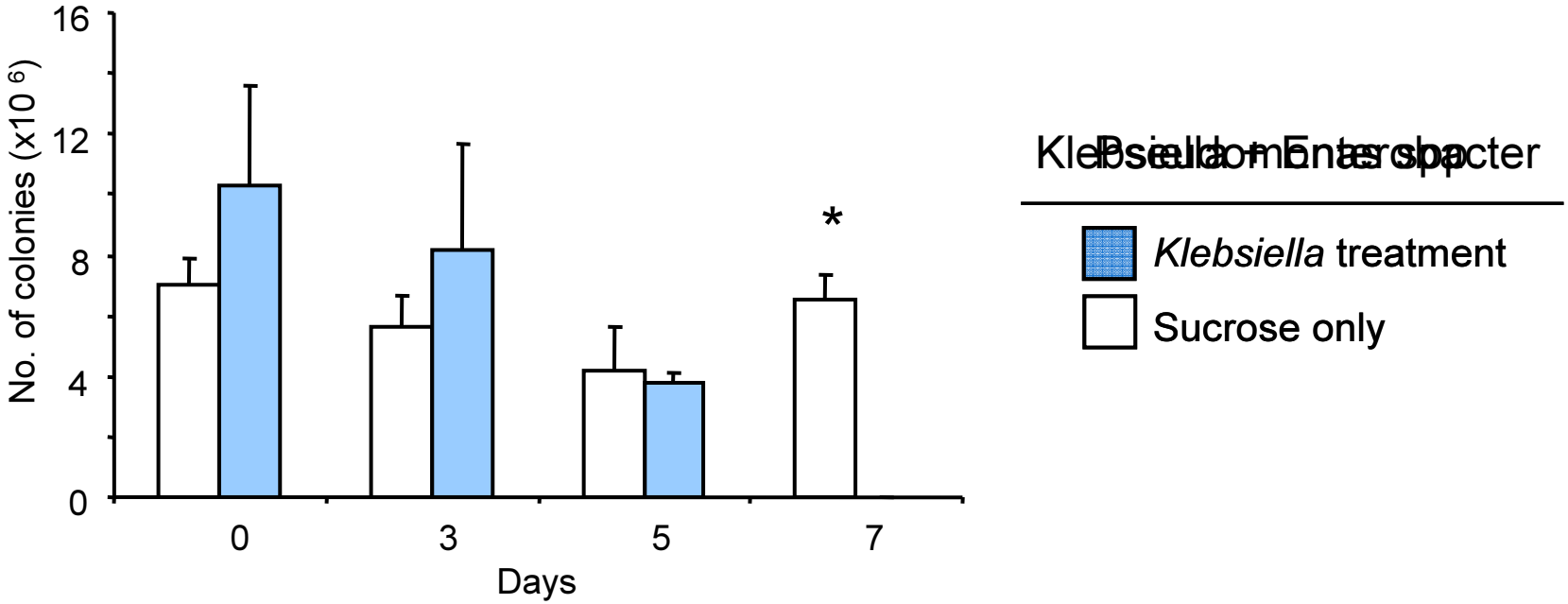


Ben-Ami et al. ISME Journal 2009

Effect of “probiotic” diet on medfly gut microbiota



2. Monitoring the establishment of *Klebsiella oxytoca* in the gut



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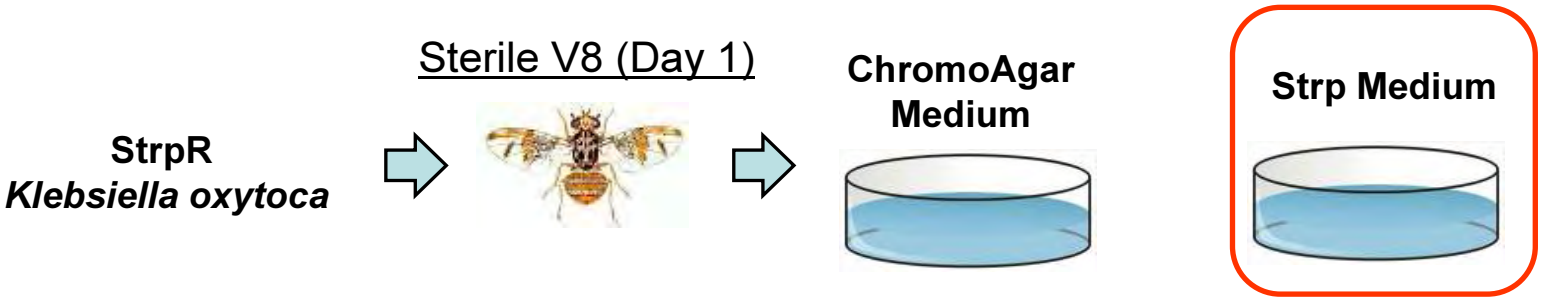

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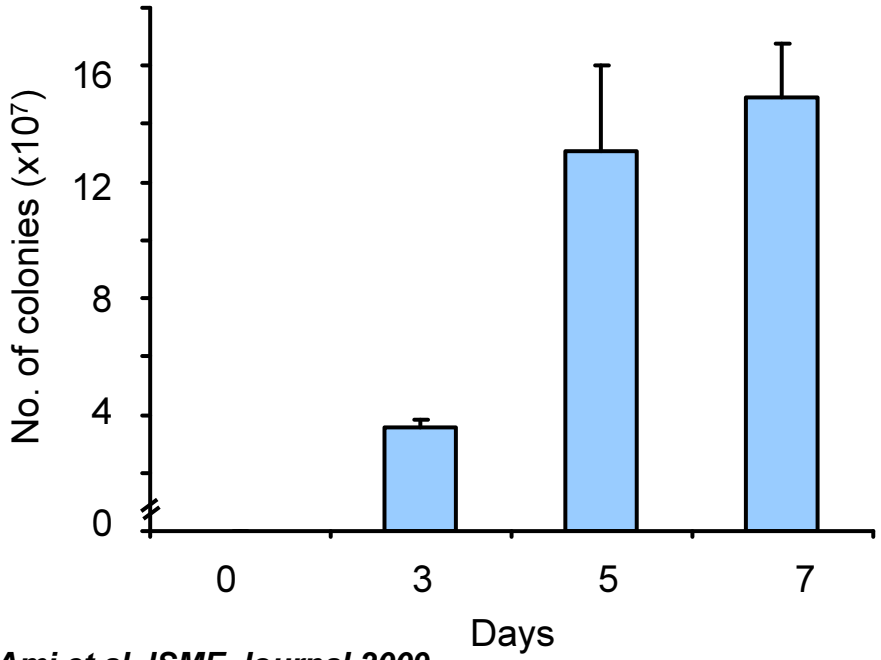

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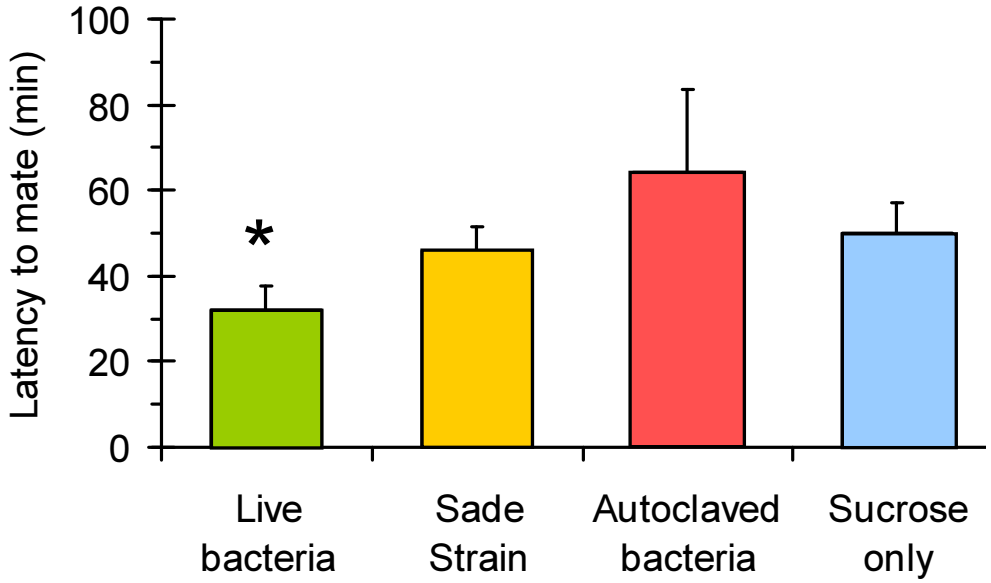
All StrpR colonies turned blue on ChromAgar

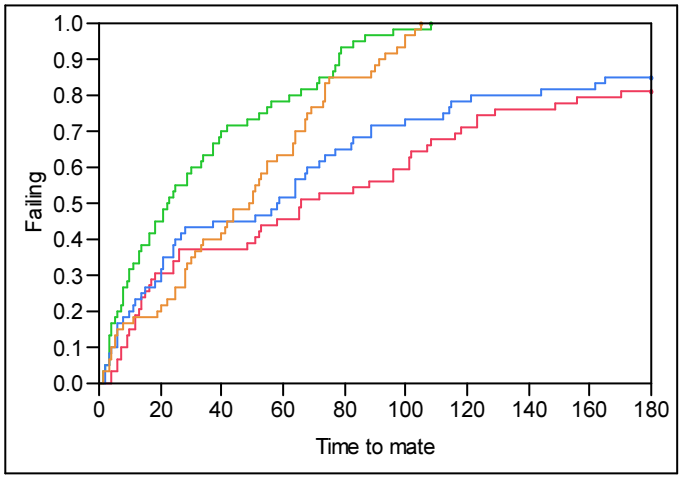
16SrRNA Sequencing: *Klebsiella oxytoca*

Effect of “probiotic” diet on male competitiveness

“Sade” strain		Sterile V8 (Day 1)			“Sade” strain
♀	X				
5 days feeding on:		Live bacteria	Autoclaved bacteria	Sucrose only	Sucrose only

3. Examining copulatory success of sterile males fed with *Klebsiella oxytoca*





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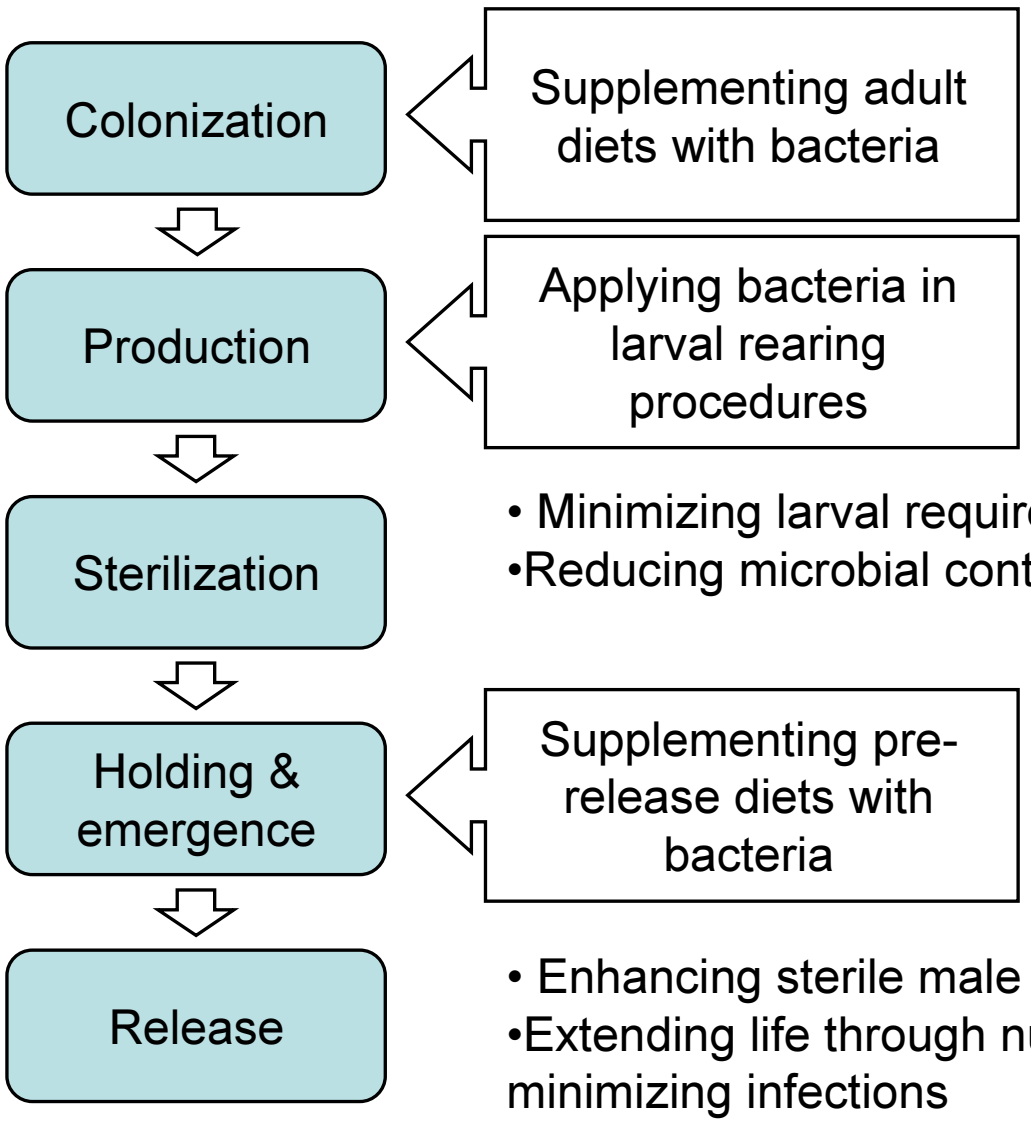
Final conclusions

- The intestinal microbiota contributes significantly to fruit fly fitness.
- Mass reared *V8* flies differ from wild flies in their gut bacterial community structure.
- The sterilizing irradiation affects the bacterial community within the gut.
- *Klebsiella oxytoca* added to the post-irradiation diet significantly improve sterile male performance.

Implementing bacteria in mass rearing of fruit flies



• Helping newly established colonies to adapt to artificial rearing conditions

• Minimizing larval requirements of nutrients
•Reducing microbial contamination

• Enhancing sterile male performance
•Extending life through nutrient provisioning, minimizing infections

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- Shlomit Shloush and Batya Kamenski
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