



Antimicrobial Activity of Insects Fats



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OUTLINE

- INSECTS FAT AS NATURAL ANTIMICROBICS
- ANTIMICROBIAL PROPERTIES OF FATS
- EXPERIMENTAL DESIGN
- RESULTS
- DISCUSSION

Insects and Antimicrobics (1)

- Epicuticular compounds (FLIES) :

Calliphora vicina pupae → 2,4 decadienal (1), PAA (1)

Sarcophaga carnaria/Calliphora vomitoria → PAA

Musca domestica → Tocopherol acetate (2)



1. Gram + (*Bacillus*, *Staph.*, *Rhodococcus*); Gram – (*E.coli*, *Pseudomonas*, *Klebsiella*);
2. Gram + (*Bacillus*, *Rhodococcus*); Gram – (*Pseudomonas*, *Klebsiella*);

Insects and Antimicrobics (2)

- Secretions:

Forcipomia nigra larvae (secretory setae):

- Pelargonic acid (++++)
- Capric acid (++)
- Palmitoleic acid (++++)
- Lauric acid (+)
- Valeric acid (+)
- Caprylic acid (++)
- Enhantic acid (++)



B. cereus; B. subtilis; P. aeruginosa; C. freundii; Enterococcus faecium



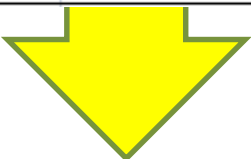
Urbaneck et al. 2012

FAs in Insects Fat/Oil



<i>S. carnaria</i>	<i>T. molitor</i>	<i>H. illucens</i>	<i>A. domesticus</i>	<i>Z. morio</i>	<i>G. assimilis</i>
Oleic	Oleic	Lauric	Linoleic	Palmitic	Linoleic
Palmitoleic	Palmitic	Myristic	Palmitic	Linoleic	Oleic
Linoleic	Linoleic	Palmitic	Oleic	Oleic	Palmitic
Palmitic	Stearic	Oleic	Stearic	Stearic	Stearic
Stearic	Myristic	Linoleic	Myristic	Myristic	Palmitoleic
Myristic	Palmitoleic	Palmitoleic	ALA	Arachidonic	Arachidonic
Arachidic	Lauric	Capric	Palmitoleic	Palmitoleic	Lauric
	Arachidonic	ALA	Arachidonic	ALA	ALA
		STD	Lauric	Lauric	Myristic

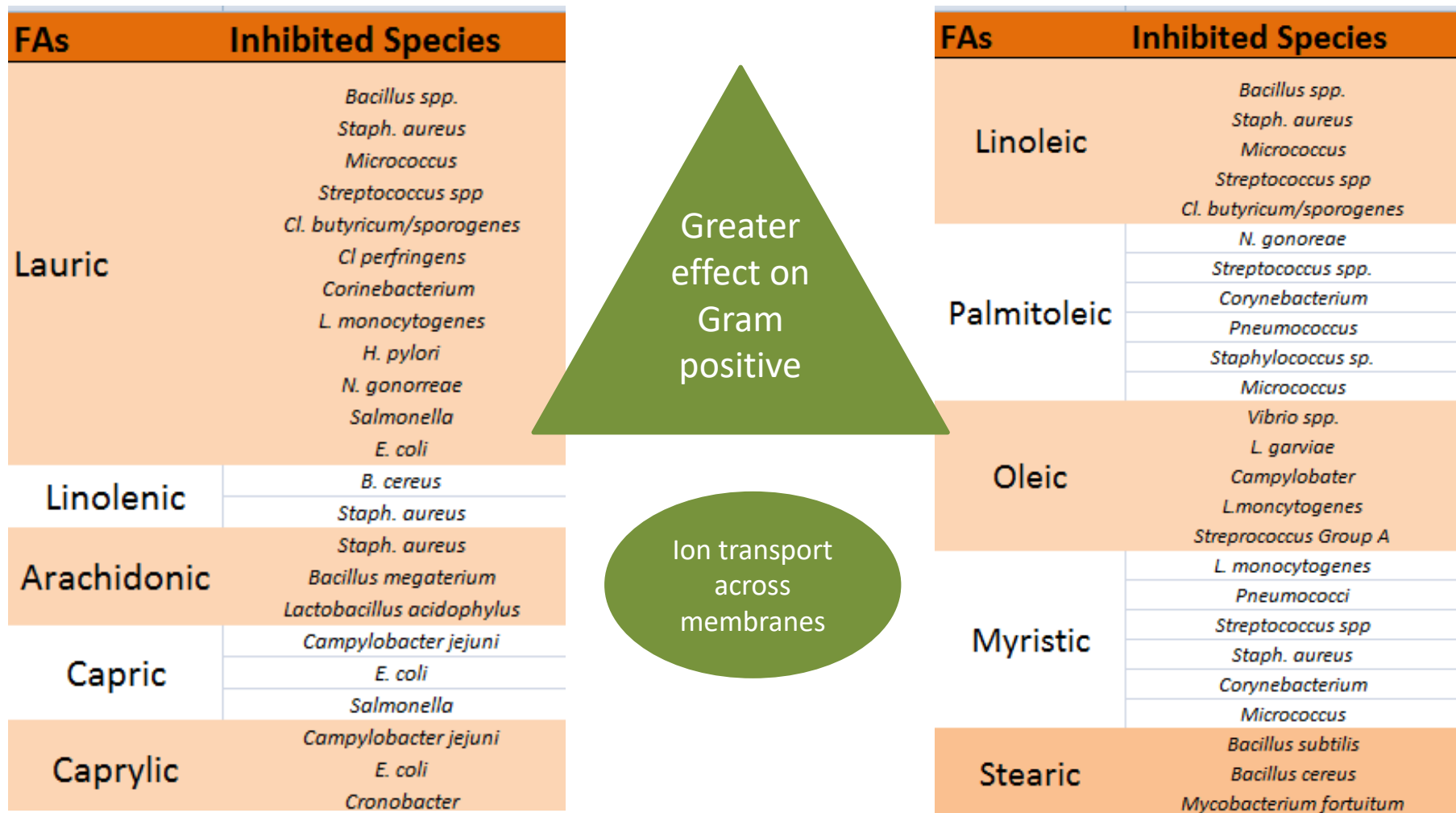
FAs order: most - least abundant
(green MUFA/PUFA; blue SFA)



Concentrations vary: DIET AND DEVELOPMENT STAGE

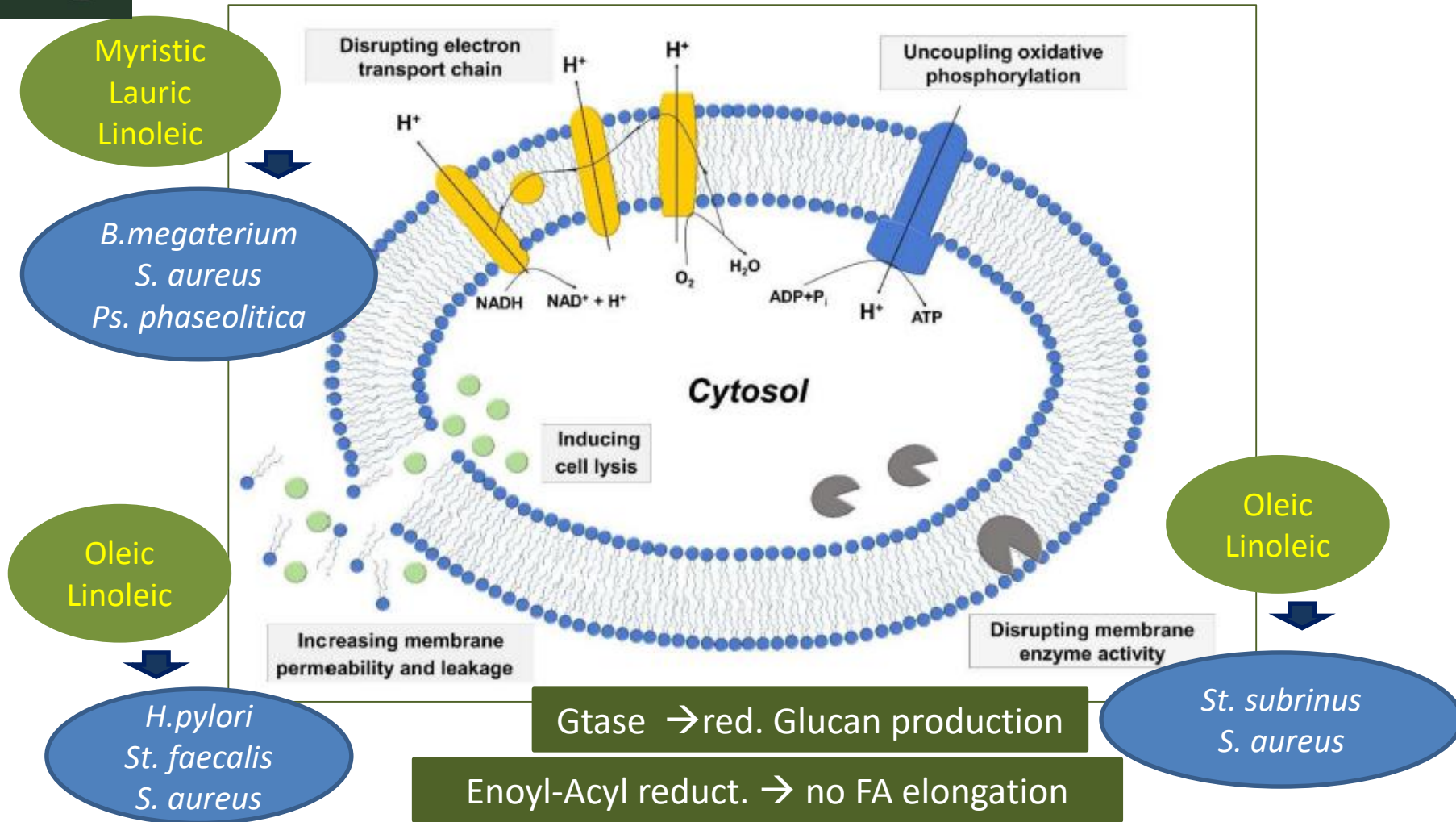
Bondioli et al, 2013; Finke, 2015; Spranghers et al. 2016; Adamkova et al. 2017

Antimicrobial activity of FAs



Xiangrong et al. 2002; Hinton and Ingram 2009; Anzacu et al. 2017; Anacarso et al. 2017; Yoon et al 2018

FAs' Antimicrobial Mechanisms



Yoon et al 2018

Practical Applications

- *Hermetia illucens* prepupae in diet of weaned piglets

- Extraction of Fat → Lauric acid (≈60%)

- *In vitro* effect on reducing the microbial load of *D-streptococci*, *Lactobacilli*
 - *In vivo*: reduced effect on gut *D-streptococci* (early absorption)



- *Aspongopus viduatus* (melon bug) oil

- Food preservation / Pharmaceutical use (Sudan)

- High content of Oleic acid (47%)
 - *In vitro*: effect on *Staph . aureus*; *B. cereus /subtilis* and *Salmonella enterica*



Aim

ANTIBACTERIAL ACTIVITY of oils from *Hermetia Illucens* and *Tenebrio molitor*

on



Sosa and Fogliano 2017

- *Listeria monocytogenes*
- *Salmonella Tiphymurium*
- *Salmonella Enteritidis*
- *Pasteurella multocida*
- *Yersinia enterocolitica*

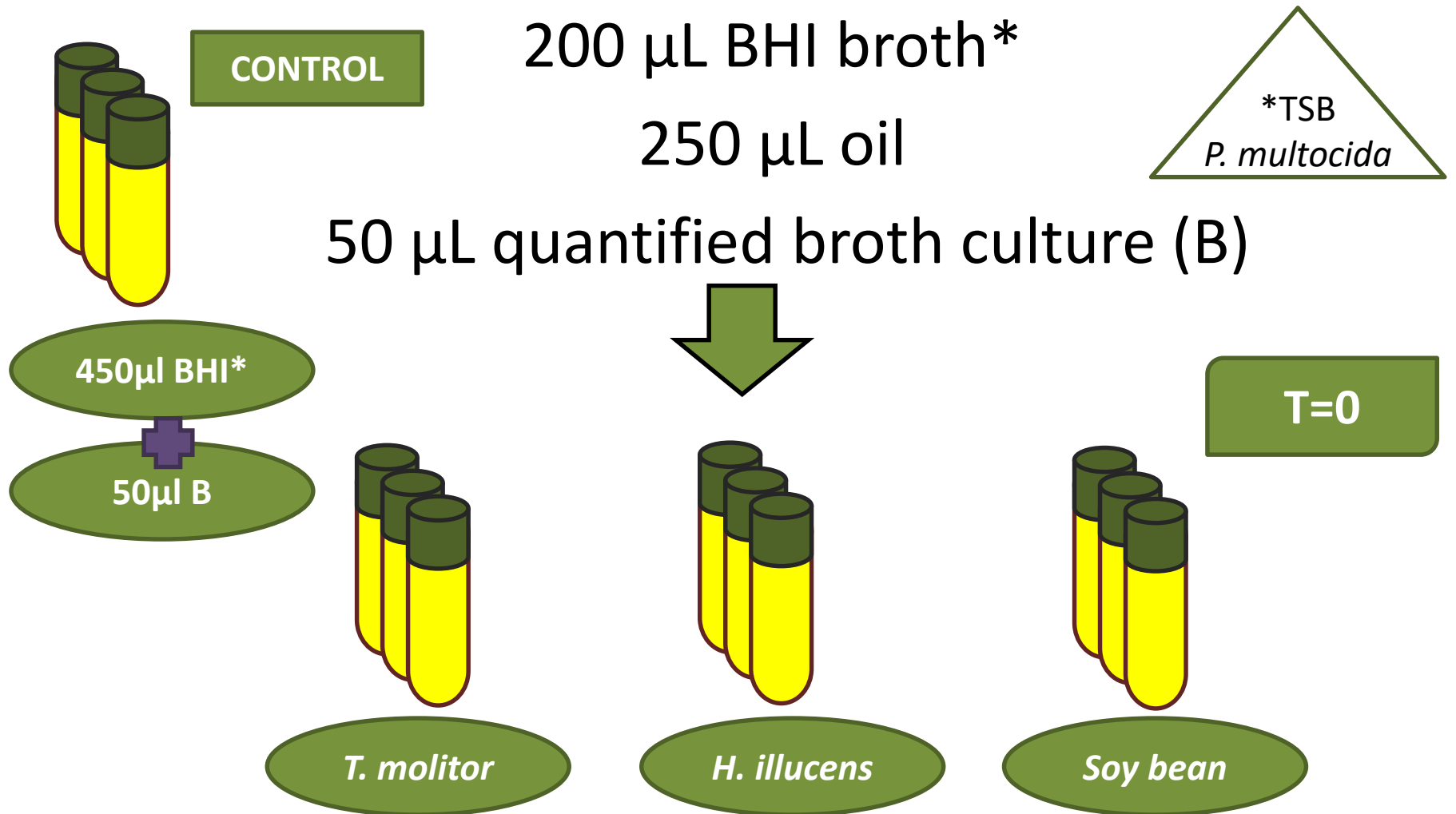
Potential application in food/feed preservation and animal health

Experimental Design

- Bacterial reference strains were bought from the Pasteur Institute (selected pathogens)
- Insects' commercial oils were used and the composition in FAs was assessed by GC



Trial preparation: TRIPLICATES

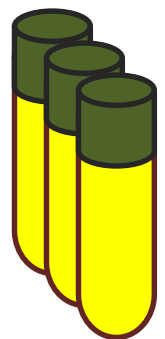


Triplicates over times

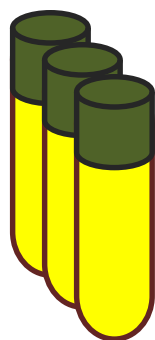
T = 4; T=6;
T=8; T=10;
T=12; T= 24



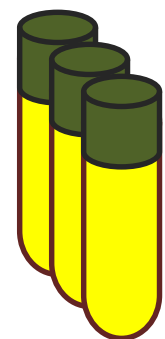
37°C



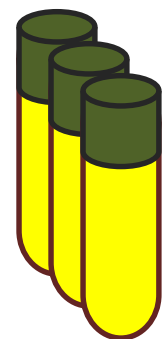
CONTROL



T. molitor

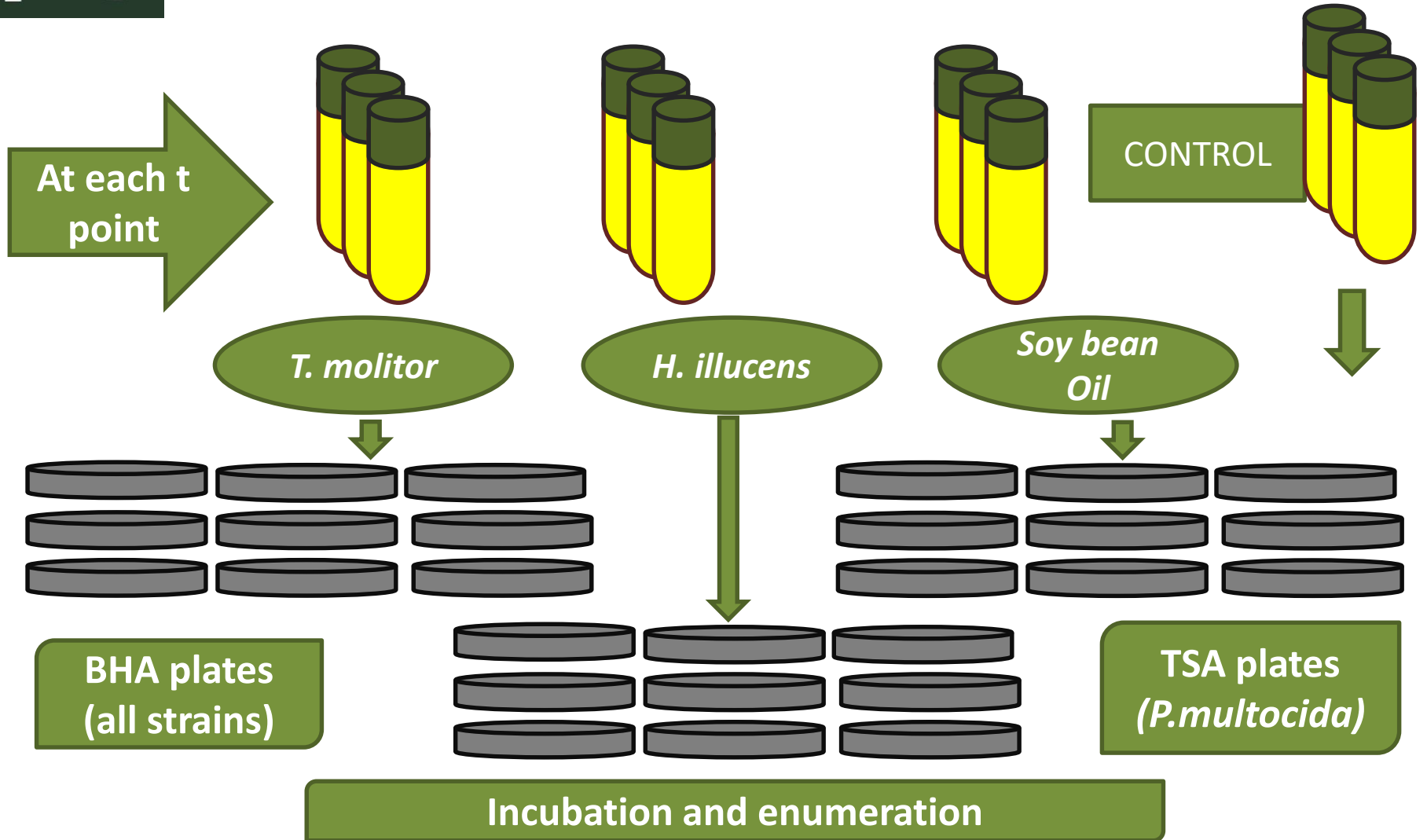


H. illucens

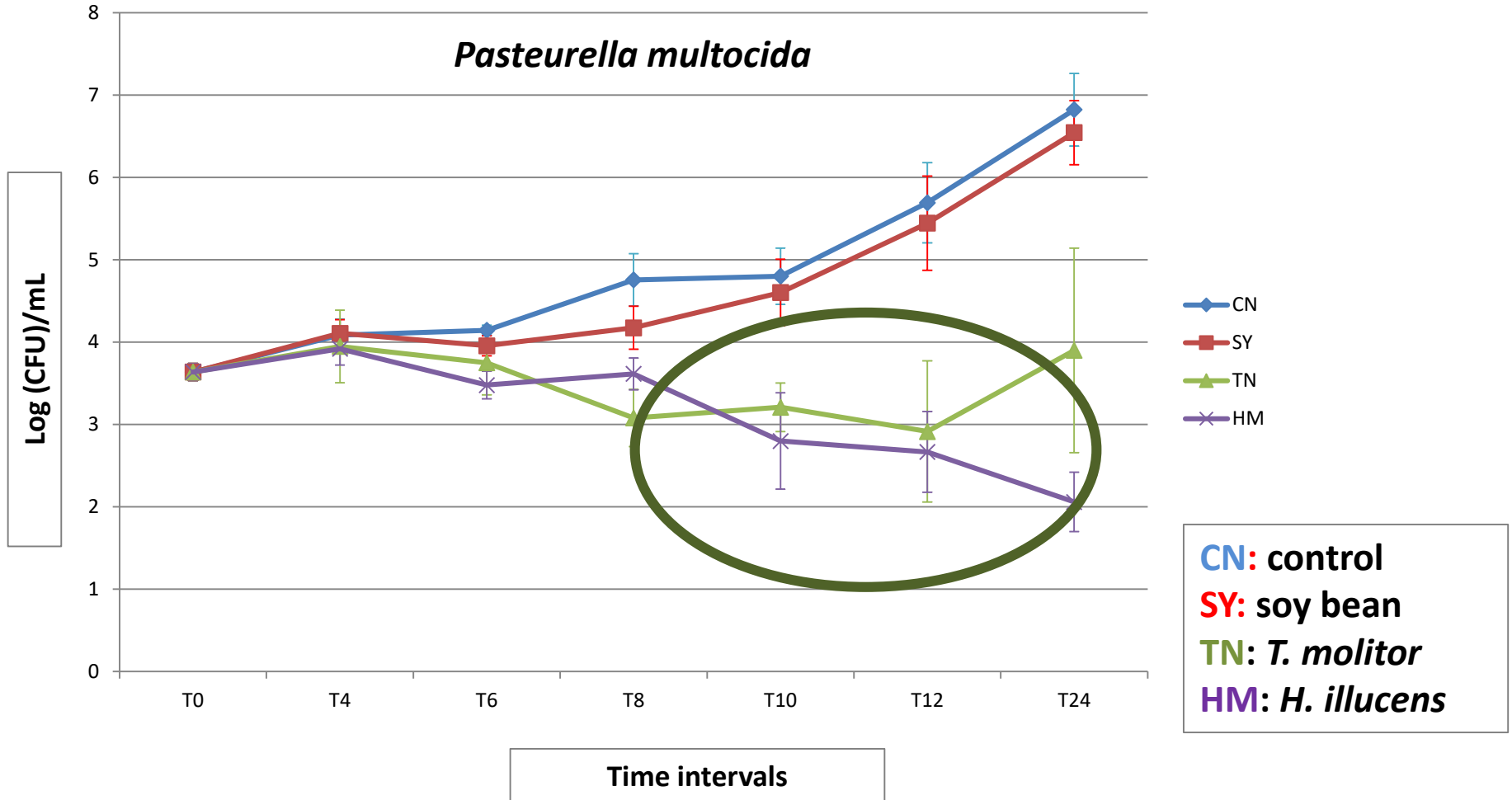


Soy bean Oil

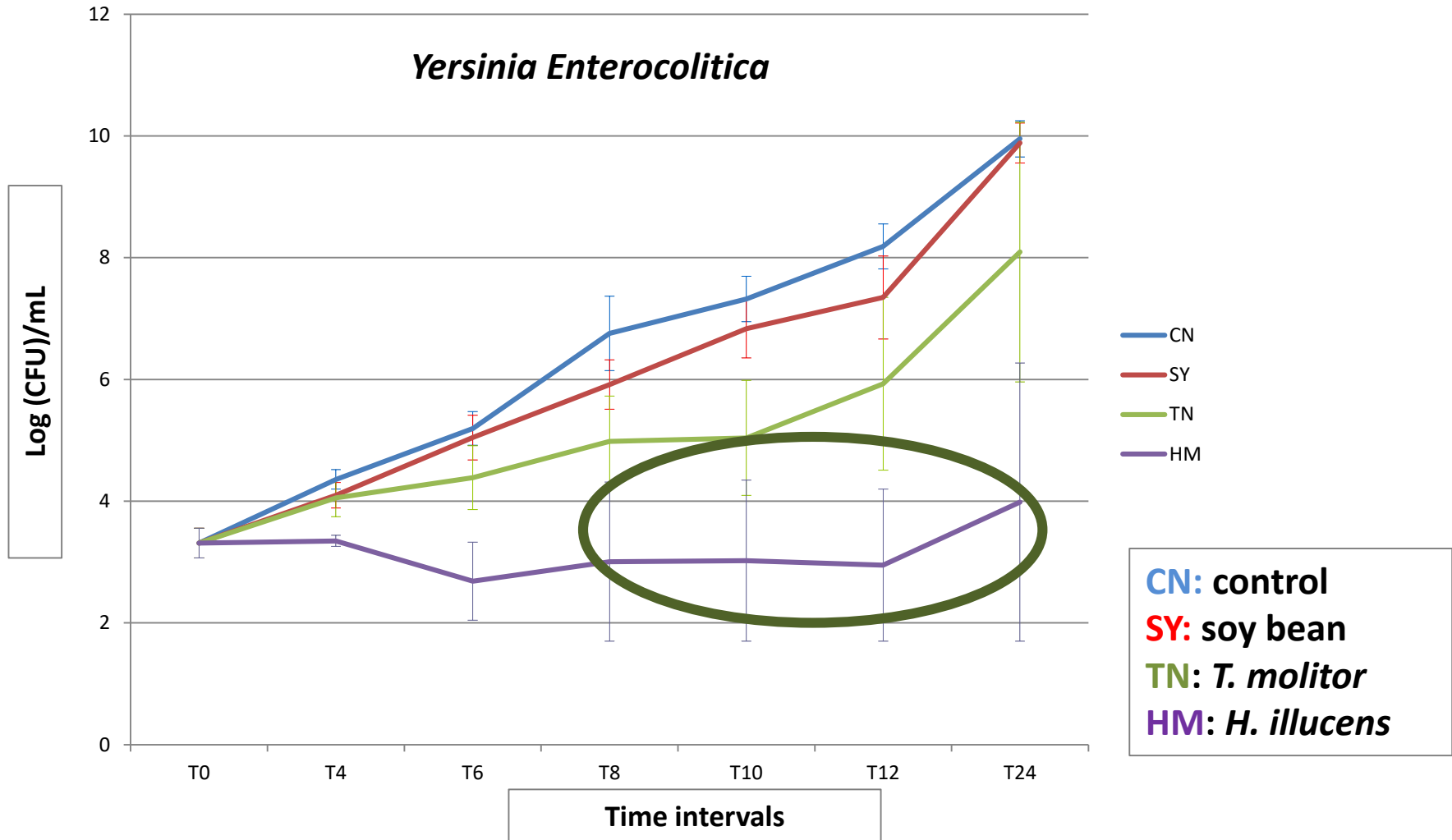
Plate Streaks



Results (1)

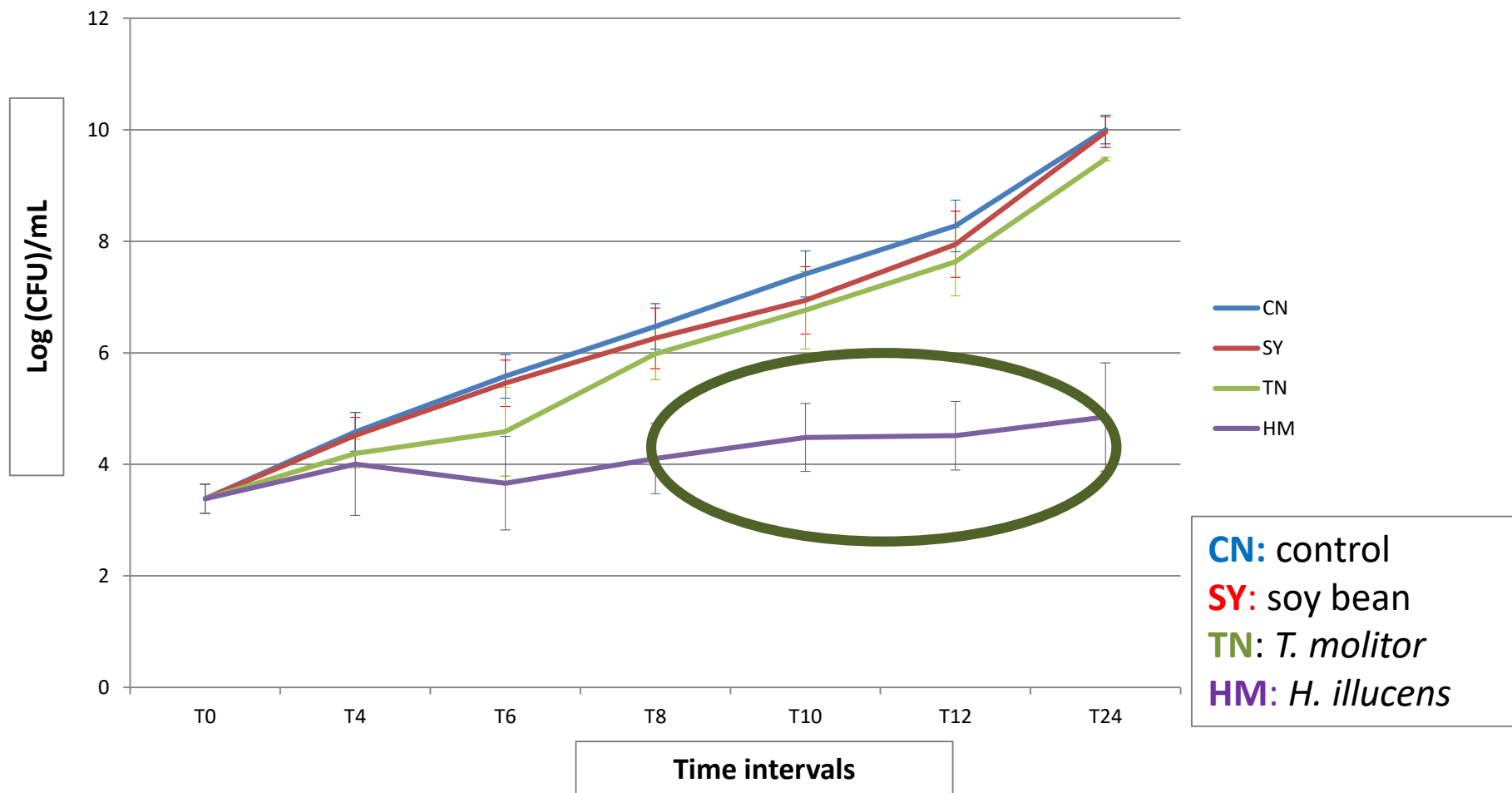


Results (2)

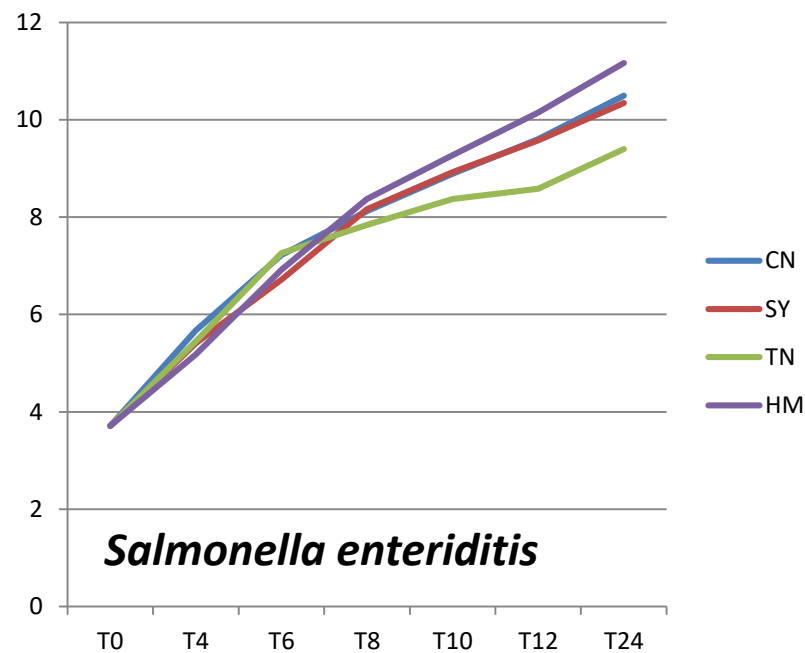
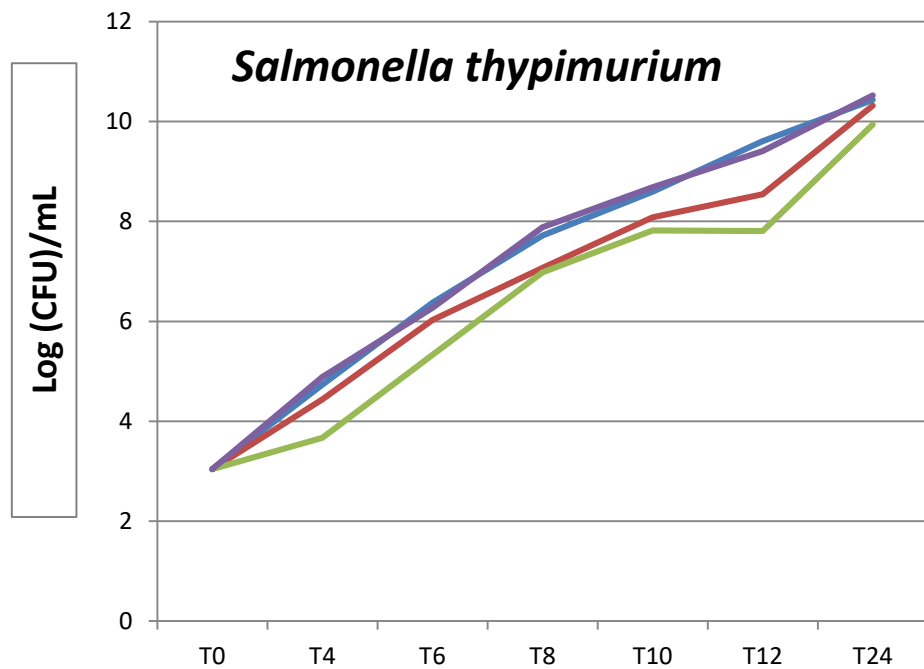


Results (3)

Listeria monocytogenes



Results (4)



Time intervals

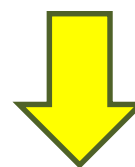
CN: control
SY: soy bean
TN: *T. molitor*
HM: *H. illucens*

NO EFFECTS

Discussion (1)

<i>H. illucens</i>	Fas	<i>T. molitor</i>	Soy
1,1	Ac. Capric	0,01	0
52,9	Ac. Lauric	0,2	0
10,4	Ac. Myristic	2,4	0,07
12,33	Ac. Palmitic	18,7	10,97
2,96	Ac. Palmitoleic	1,65	0,08
1,8	Ac. Stearic	2,32	4,39
7,88	Ac. Olieic	37,73	22,73
0,49	Ac. Vaccenic	0,65	1,61
7,82	Ac. Linoleic	33	52,58
0,79	ALA	1,63	6,67
79,11	SFA	24,7	16,05
11,82	MUFA	40,51	24,62
9,08	PUFA	34,74	59,33

On 3 /5 species tested
CRUDE oils were
effective → FAs
Composition



Dilution + incubation →
reduction of FA's
concentration/activity

Soy > *T.m* > *H. i*

Discussion (2)

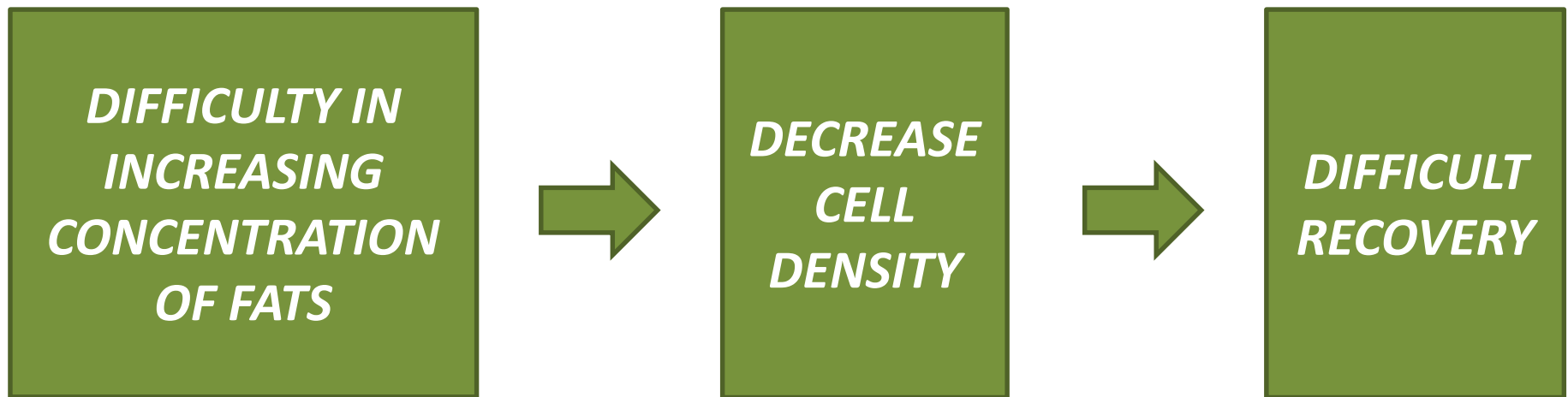
- The observed effects of *T. molitor* oil could be greater at room temperature → slower bacterial growth and reduced FAs oxidation
- *H. illucens* → high SFA (Lauric Ac.) → activity even at incubation T over times → shorter fatty chains (C10-C12-C14)



Application on feed/intestine

Discussion (3)

- *Both oils showed effect on reduction of growth*
 - cell repair mechanisms
 - dose dependent (?)



Discussion (4)

- *P. multocida* highly sensitive → more testing on wild strains together with in vivo studies (absorption of FAs → reduced activity)

Feed with insect oils may prevent growth and colonization (i.e. Rabbit)

- New analyses on free FAs by digesting oils with animal enzymes (lipases) → increased effect