
Predictive Microbiology for Spices and Herbs

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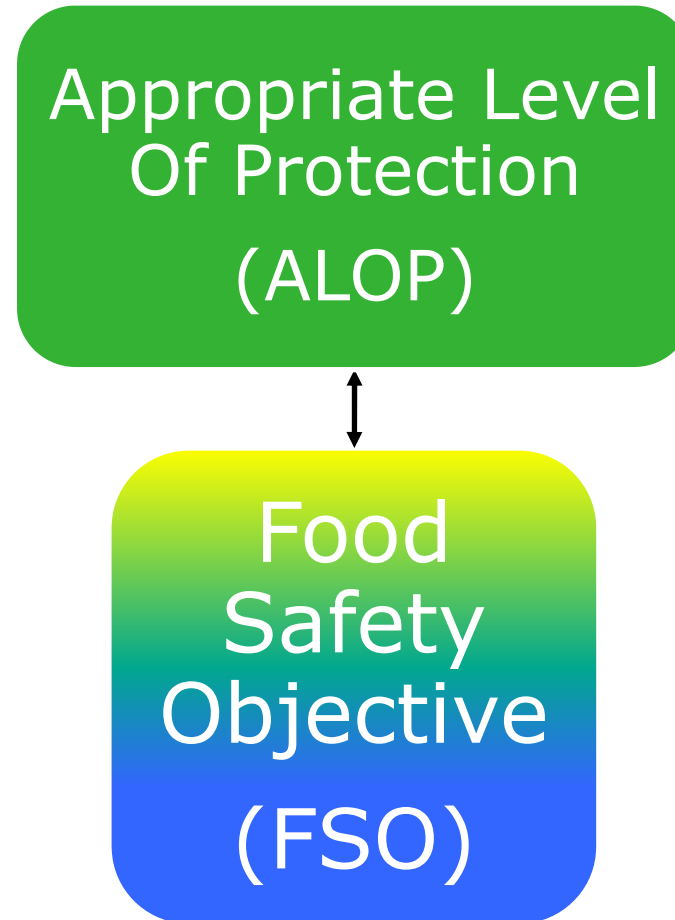
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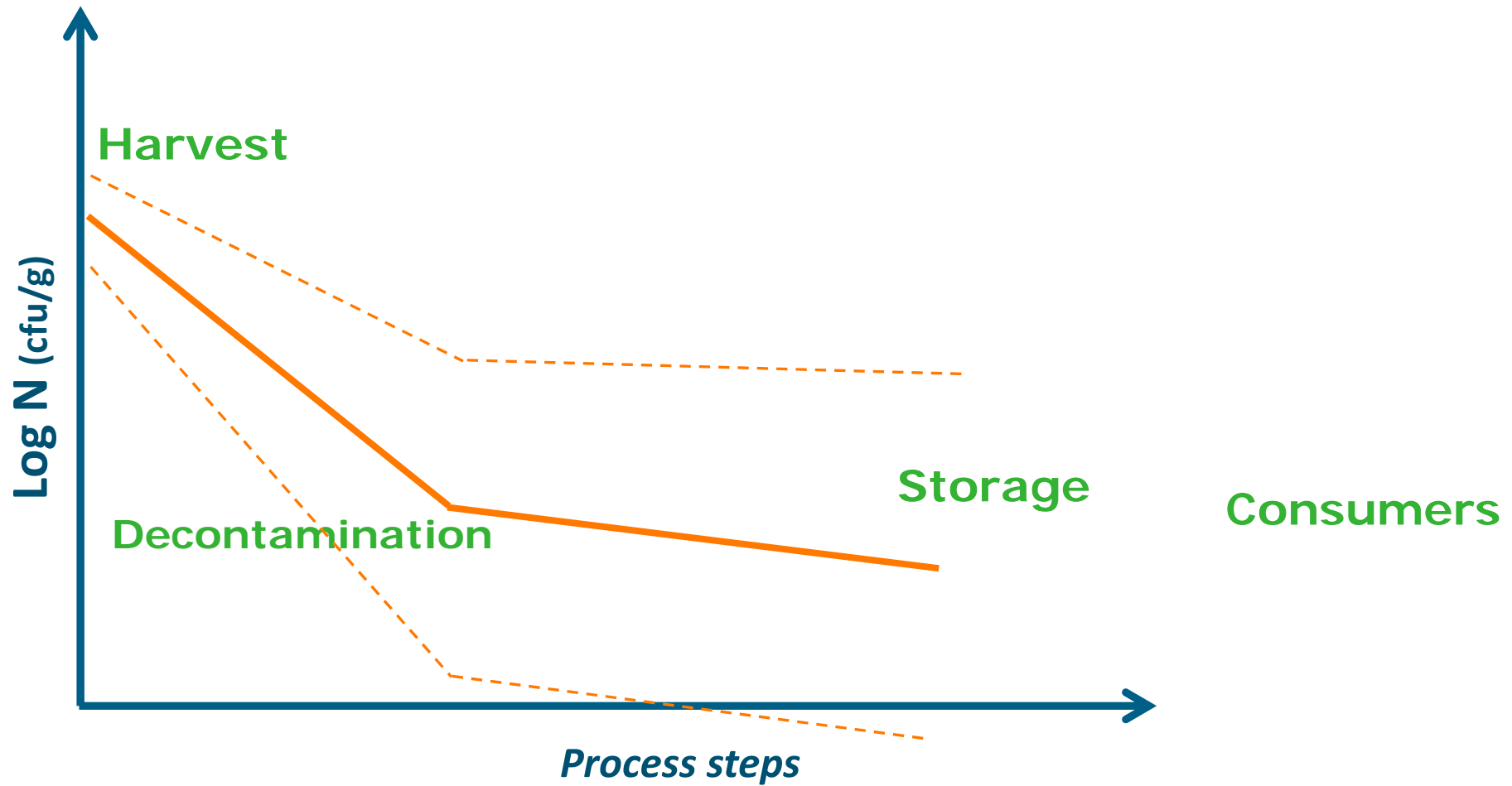
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ALOP & FSO



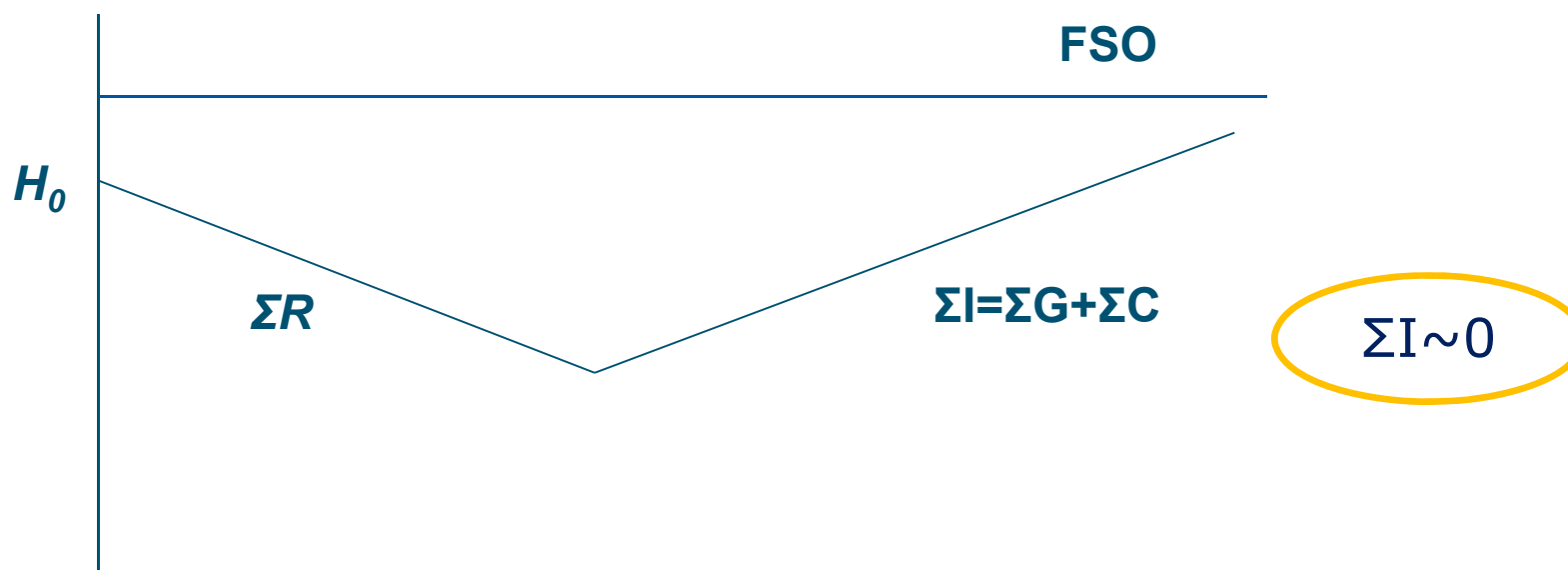
Model for Spices and Herbs



Food Safety Objective-FSO

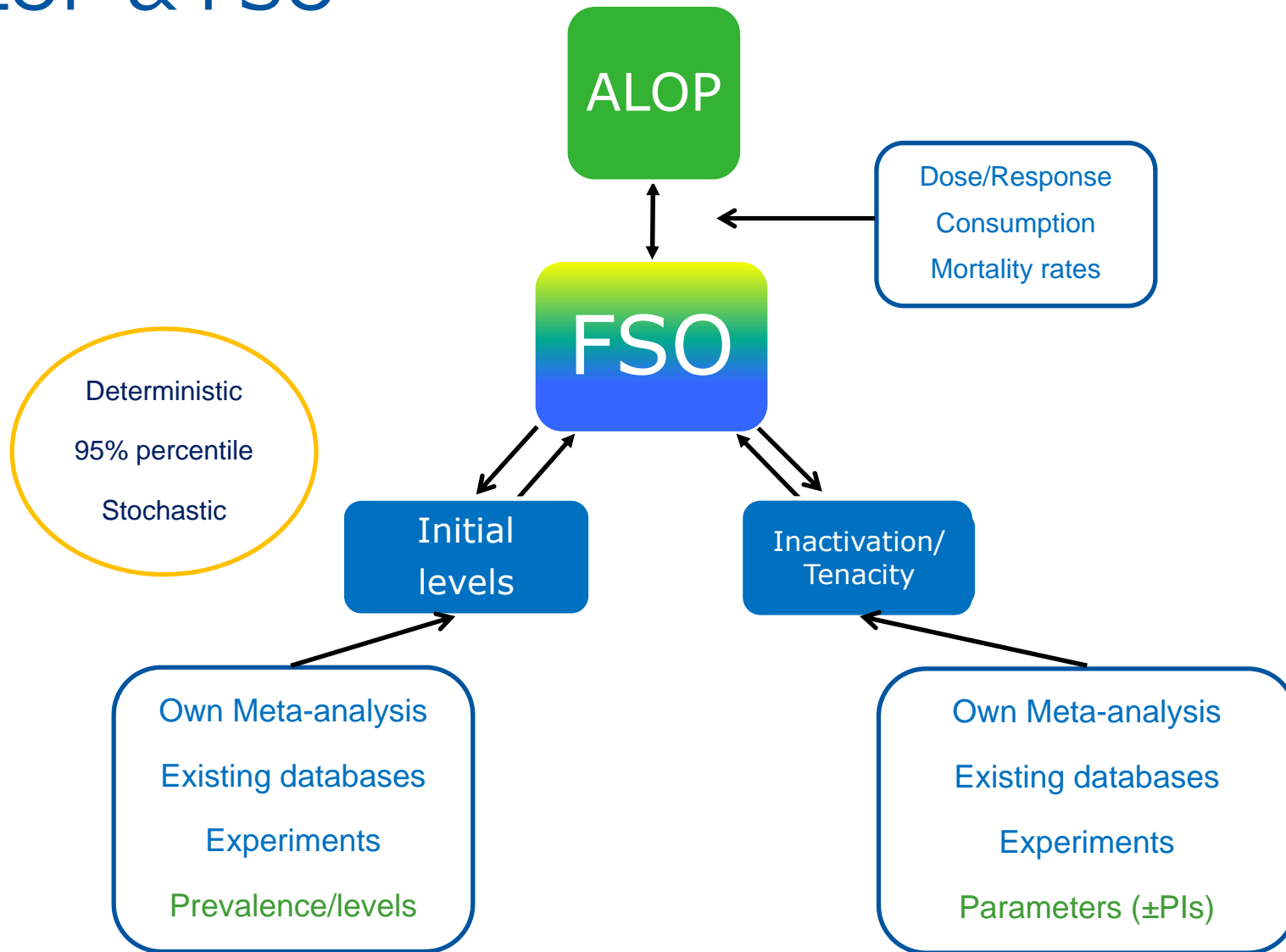
- ICMSF

$$H_0 - \Sigma R + \Sigma I < FSO$$



Zwietering, 2005

ALOP & FSO



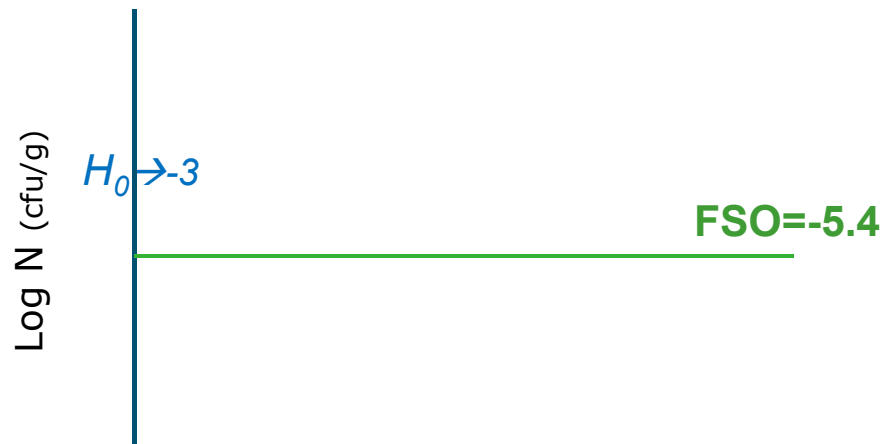
Foodborne Diseases in Spices

- *Salmonella* spp. in powder paprika
 - Other agent/matrices
- ALOP: 1 death per year per 10^8 people
 - 128 illnesses per year per 10^8 people
- *Salmonella* spp. FSO=-5.4 log cfu/g



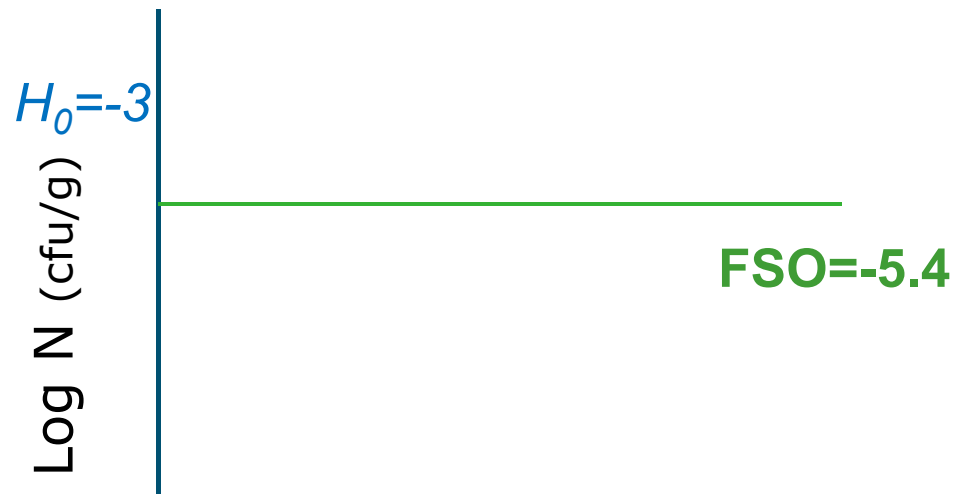
FSO Factors- H_0

- Prevalence of *Salmonella* spp. in spices
 - EU data: RASFF & EFSA data=0.03
 - Published studies: not only EU=0.05
 - WHO data: global (& EU) data=0.03
- $H_0 = -3 \log \text{ cfu/g}$
- Batch of oregano tested, absence of salmonellas



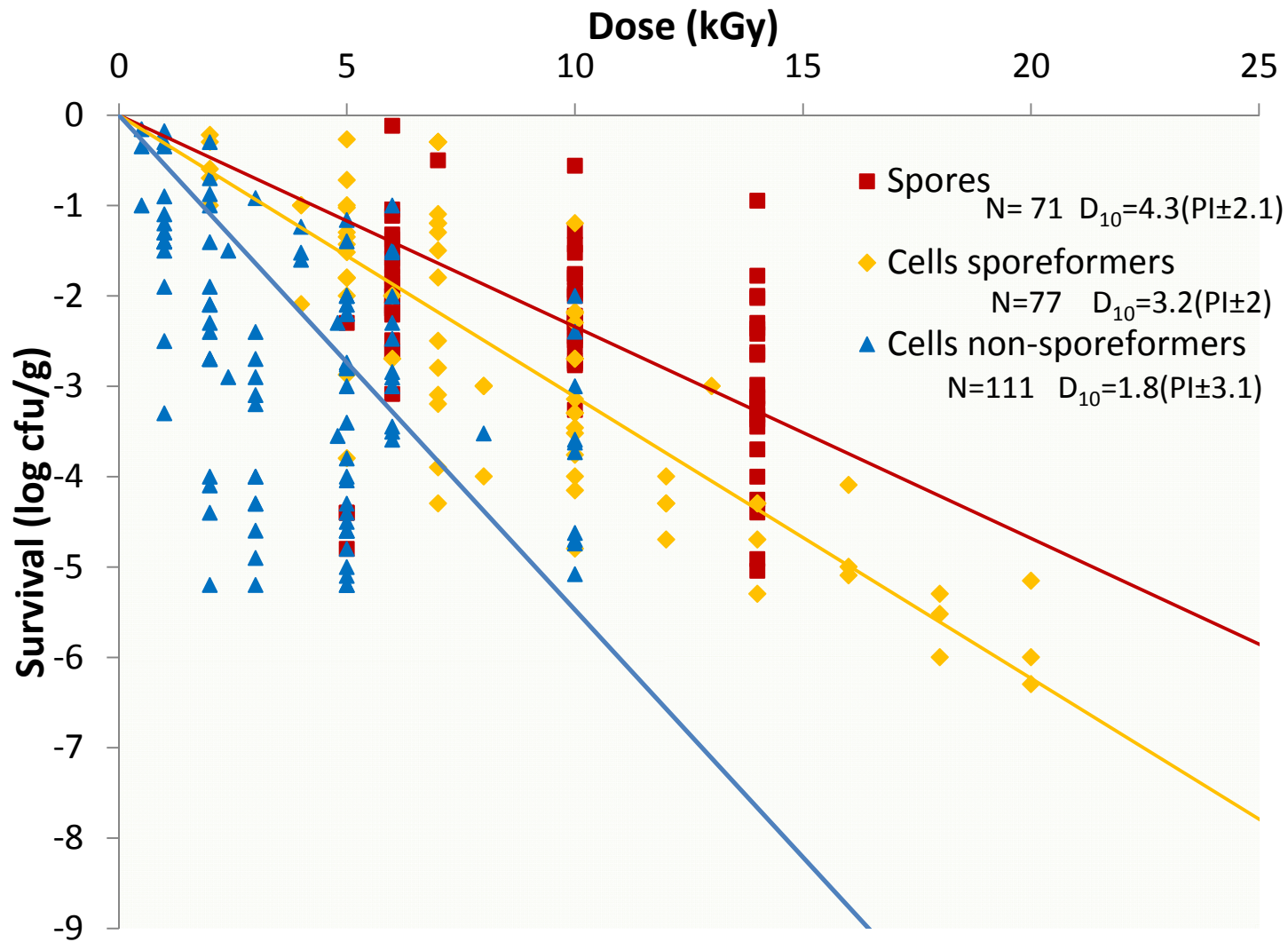
FSO Factors- $\Sigma R_{\text{Inactivation}}$

■ $\Sigma R_{\text{Inact}} = \Sigma R_{\text{Thermal}} / \Sigma R_{\text{Irradiation}}$

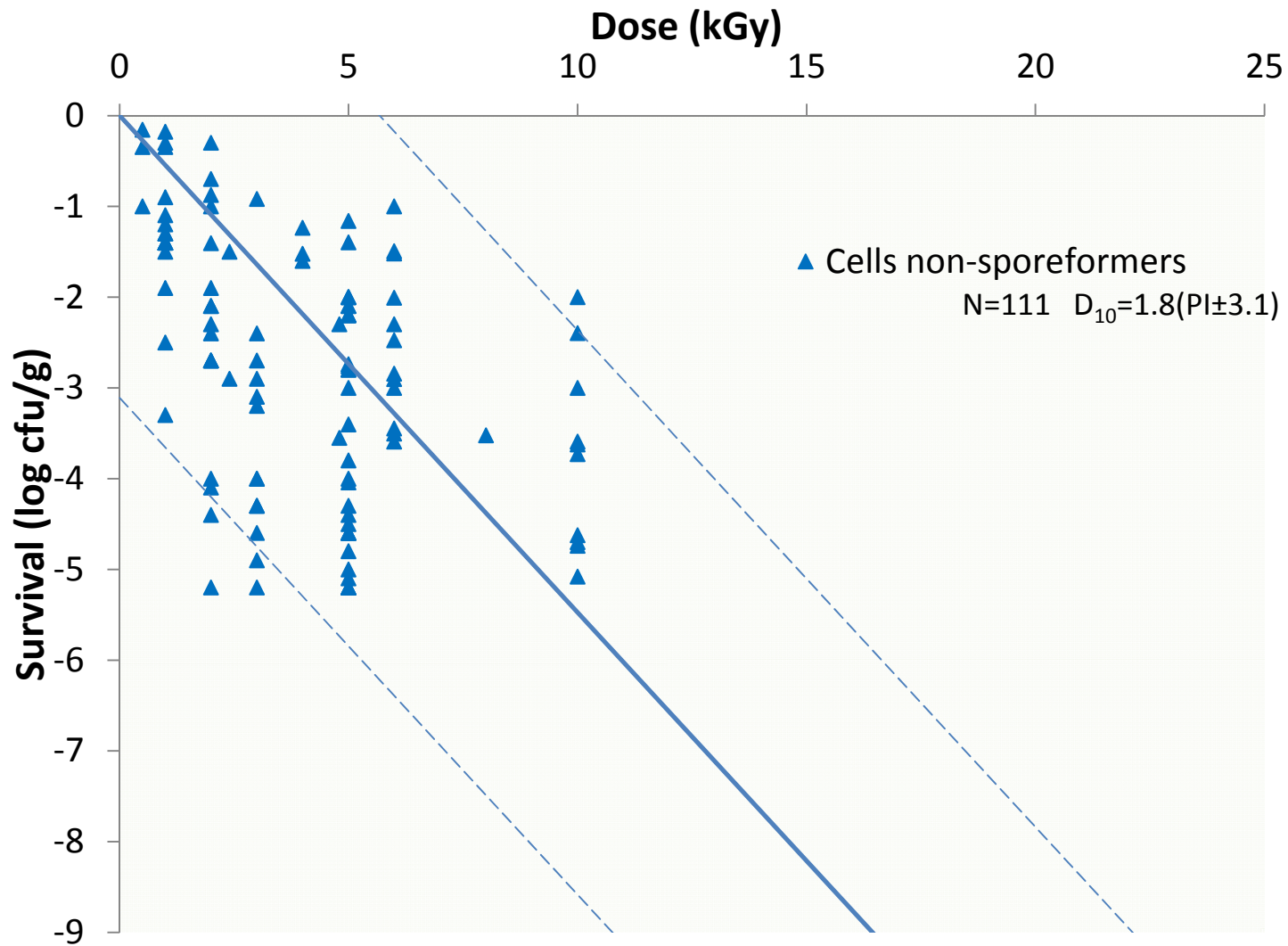


Other meta-analyses
Experimental findings

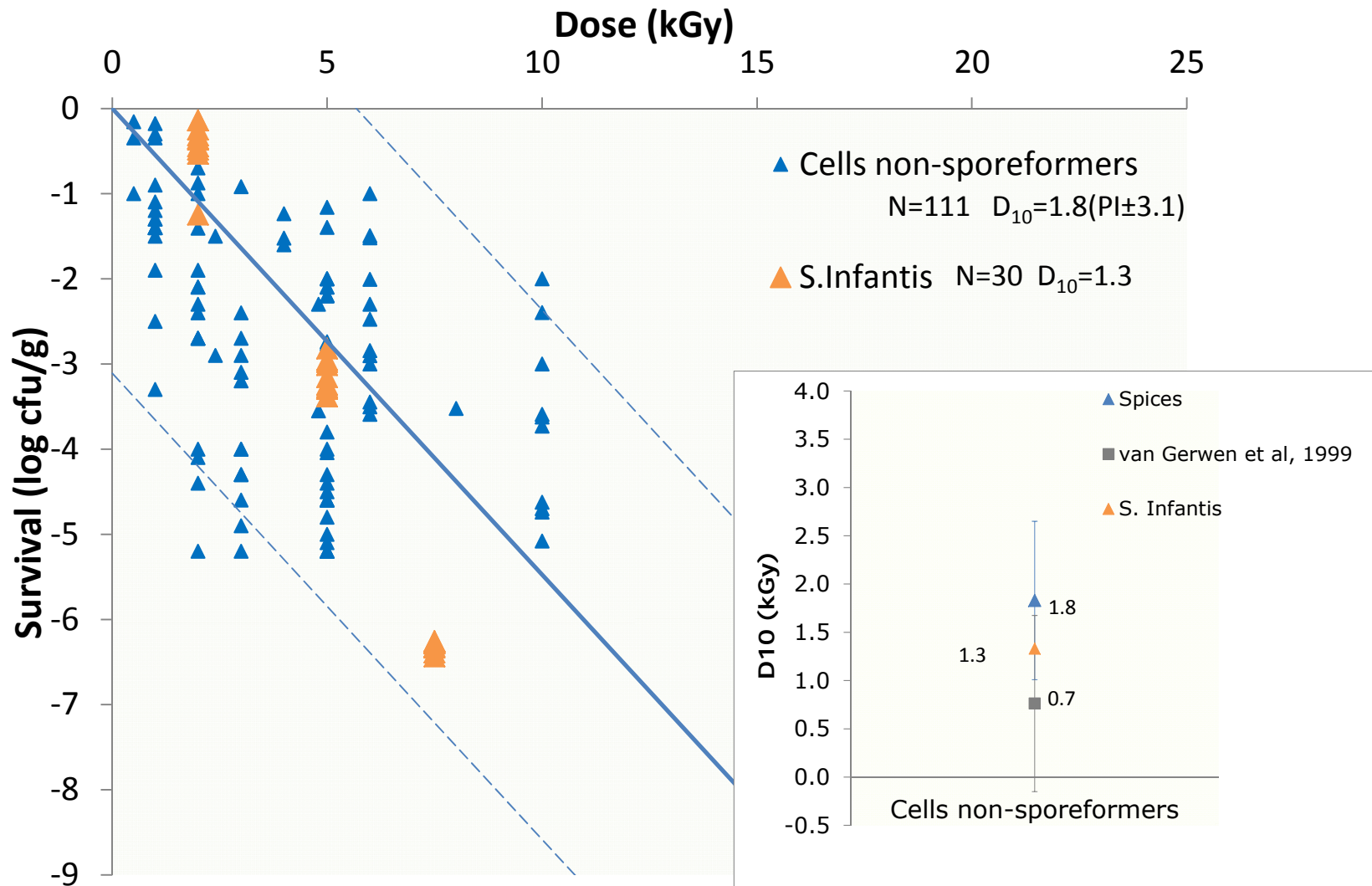
Irradiation



Irradiation

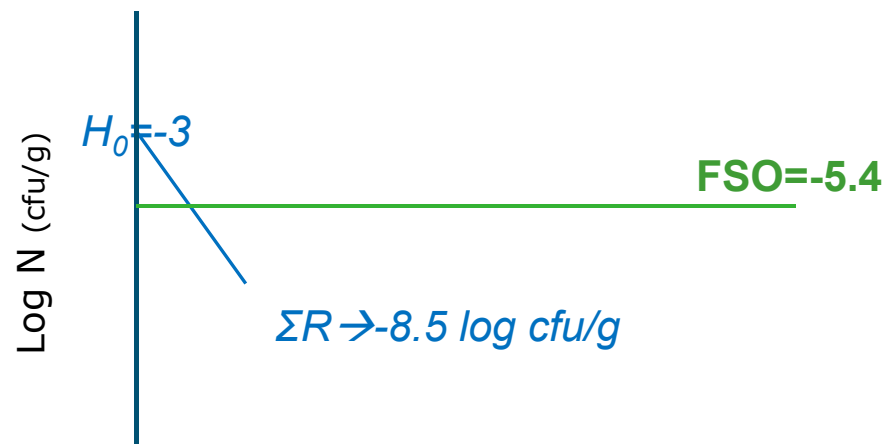


Irradiation



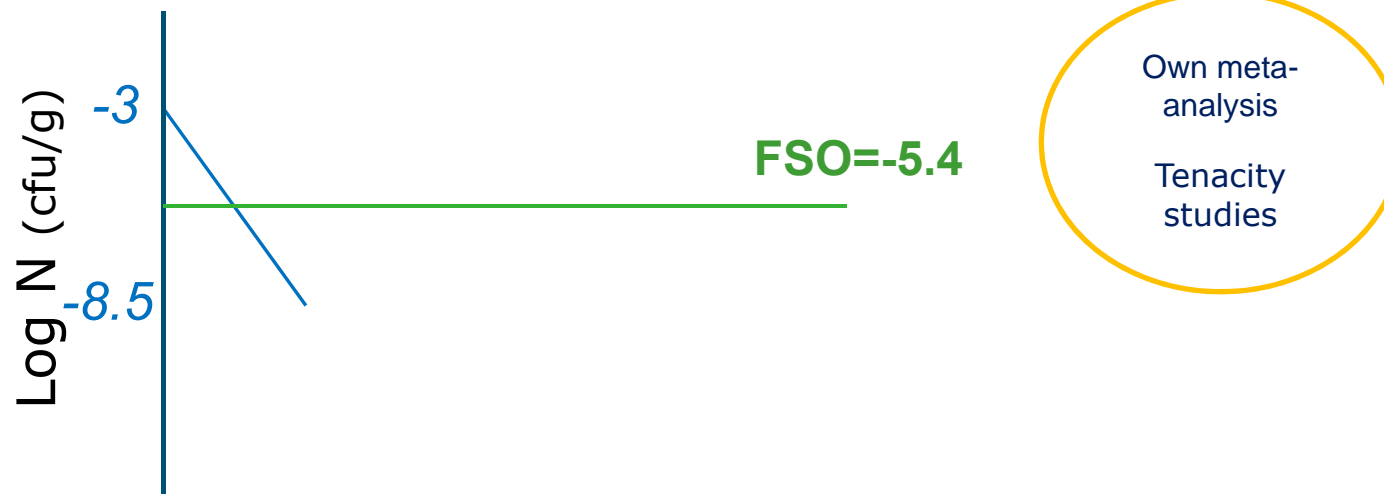
FSO Factors- $\Sigma R_{\text{Inactivation}}$

- $\Sigma R_{\text{Inact}} = \Sigma R_{\text{Irradiation}}$
- Inactivation Factors: Spores & Gram stain
 - D_{irrad} value spores: 4.3(PI \pm 2.1) kGy
 - D_{irrad} value vegetative: 1.8(PI \pm 3.1) kGy
- Irradiation of paprika: 10 kGy \rightarrow -5.5 log cfu/g

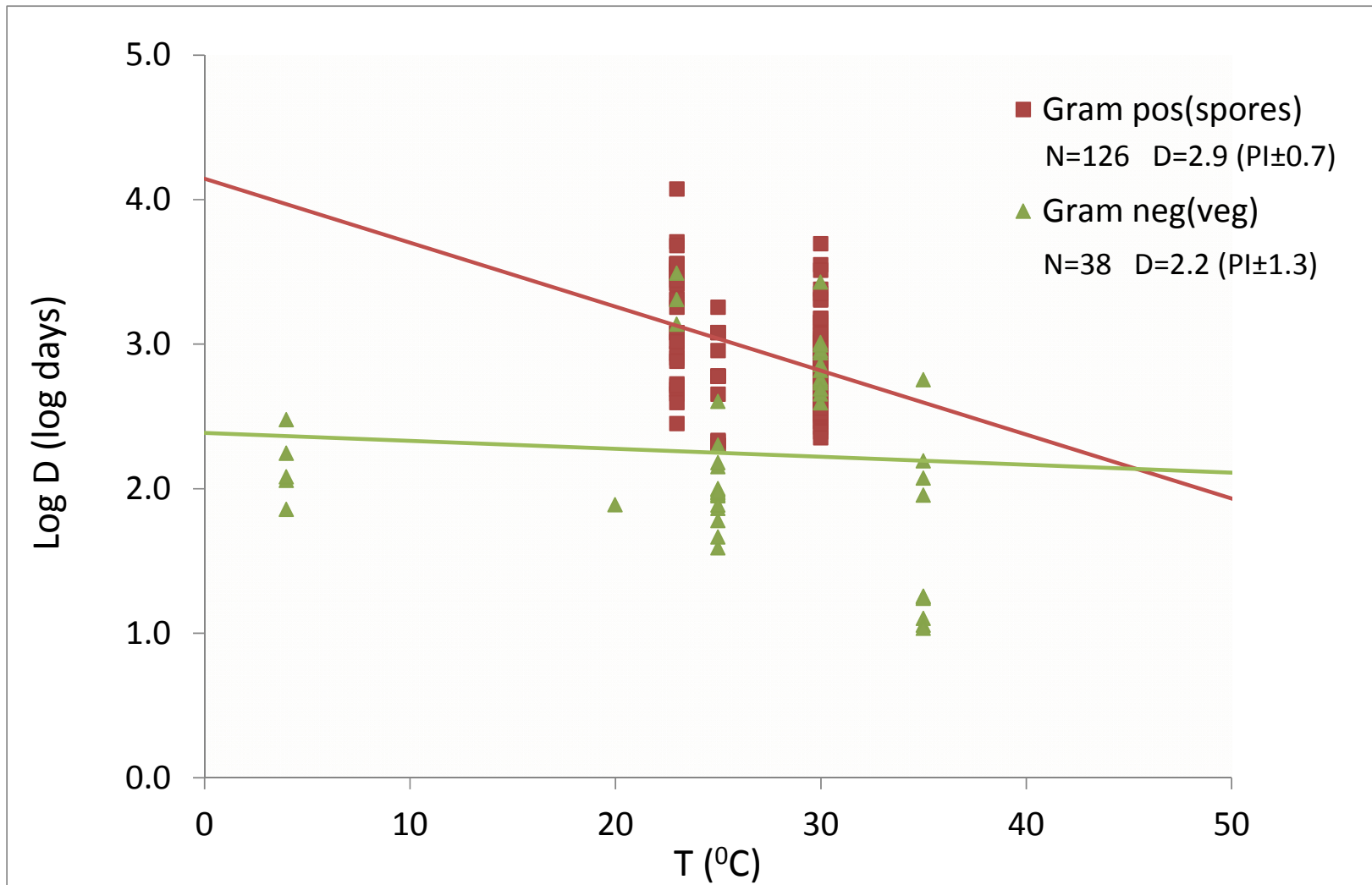


FSO Factors- $\Sigma R_{\text{tenacity}}$

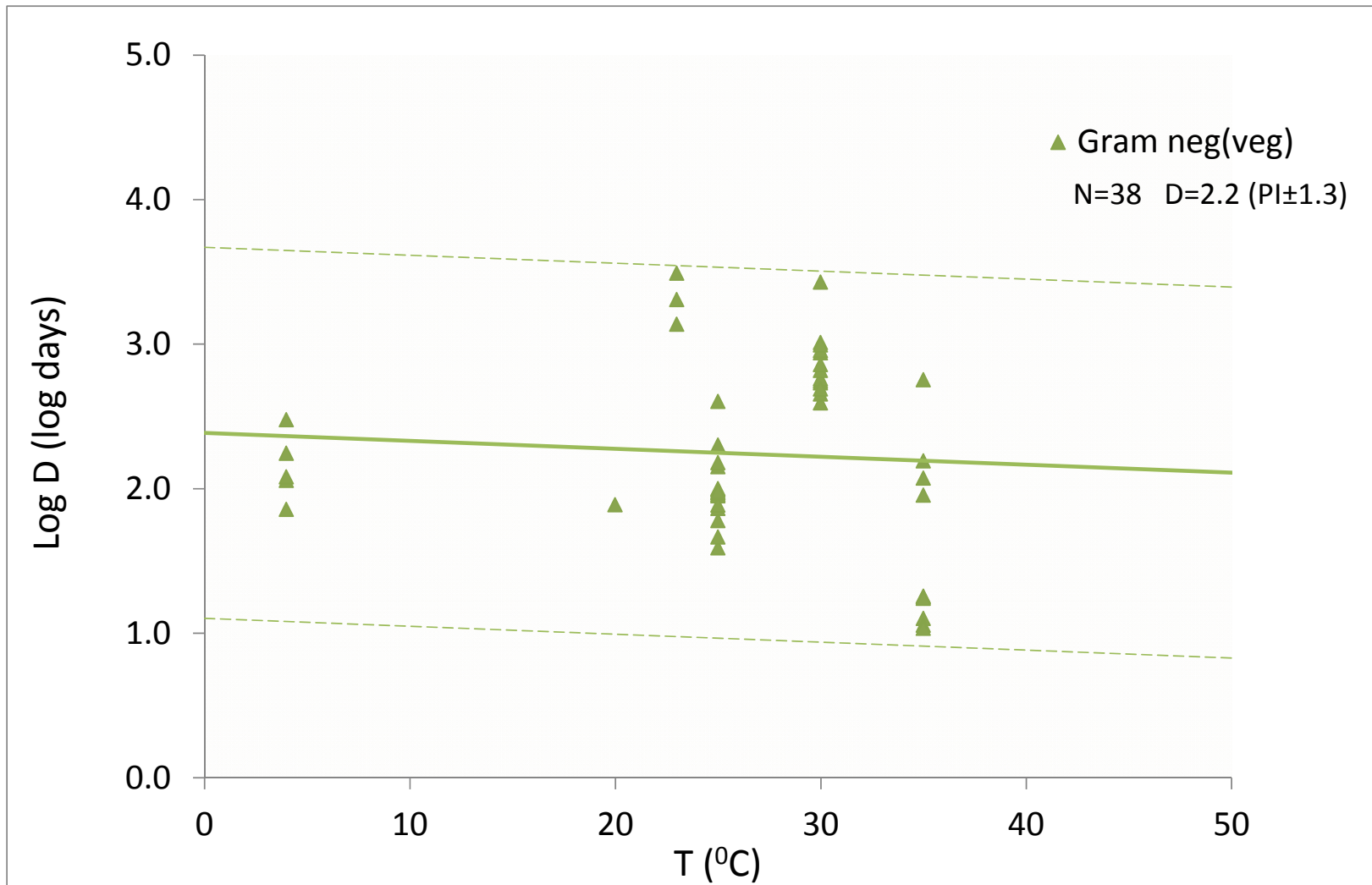
- $\Sigma R_{\text{tenacity}} \rightarrow$ Survival in storage conditions



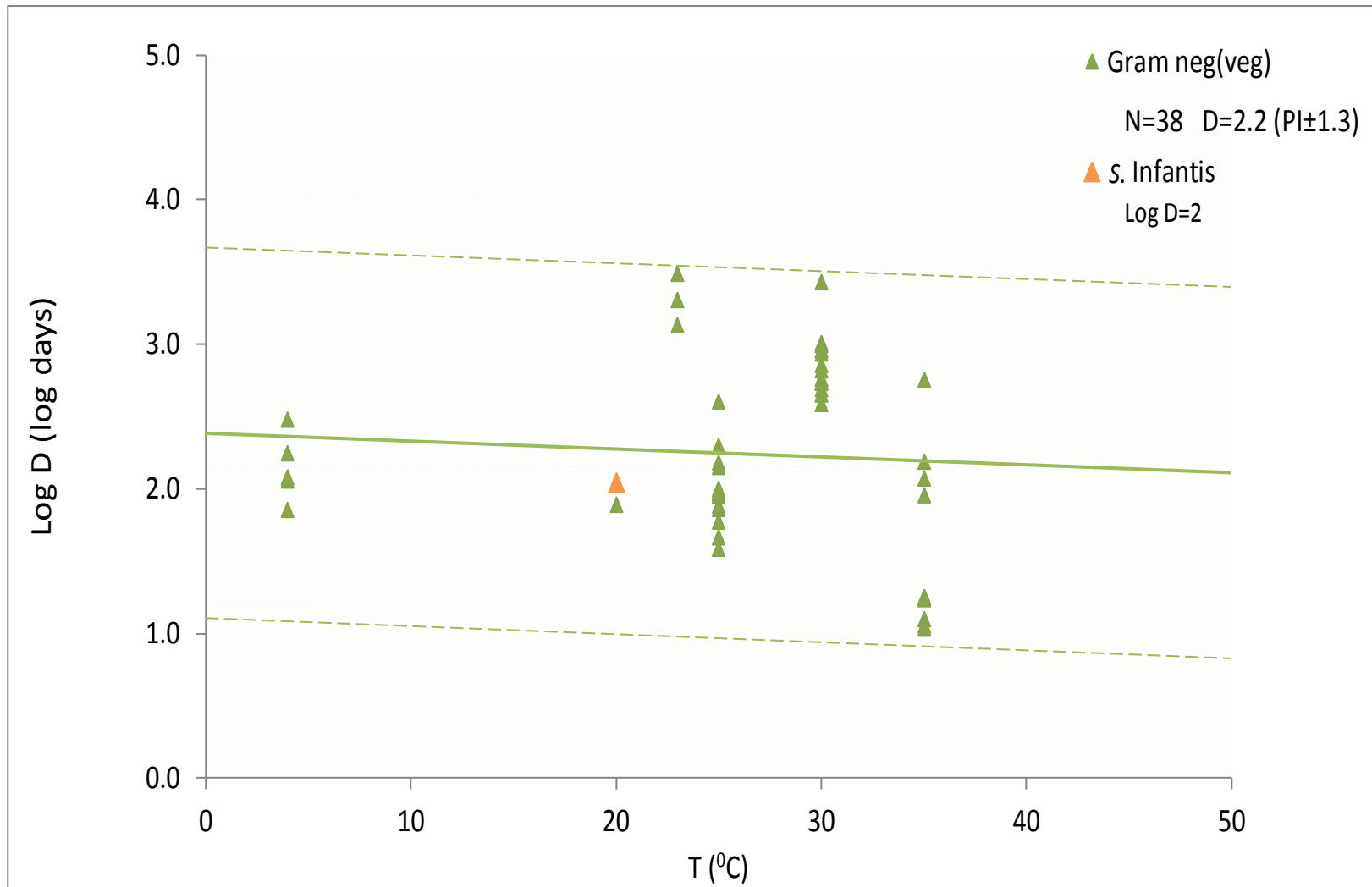
Survival



Survival

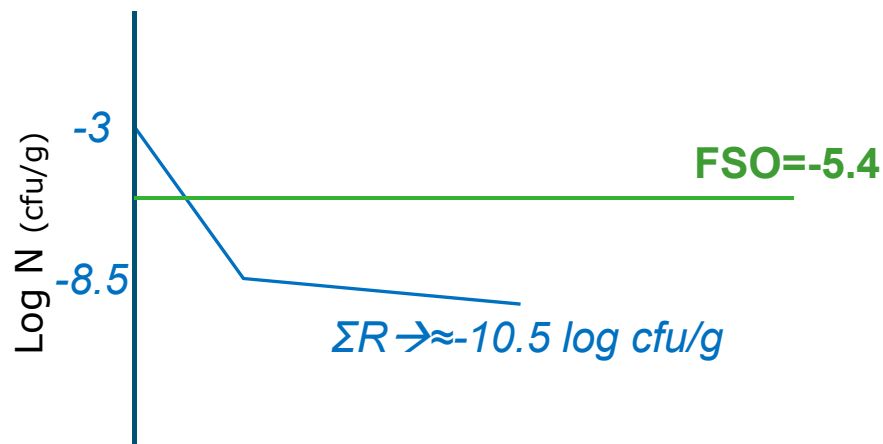


Survival

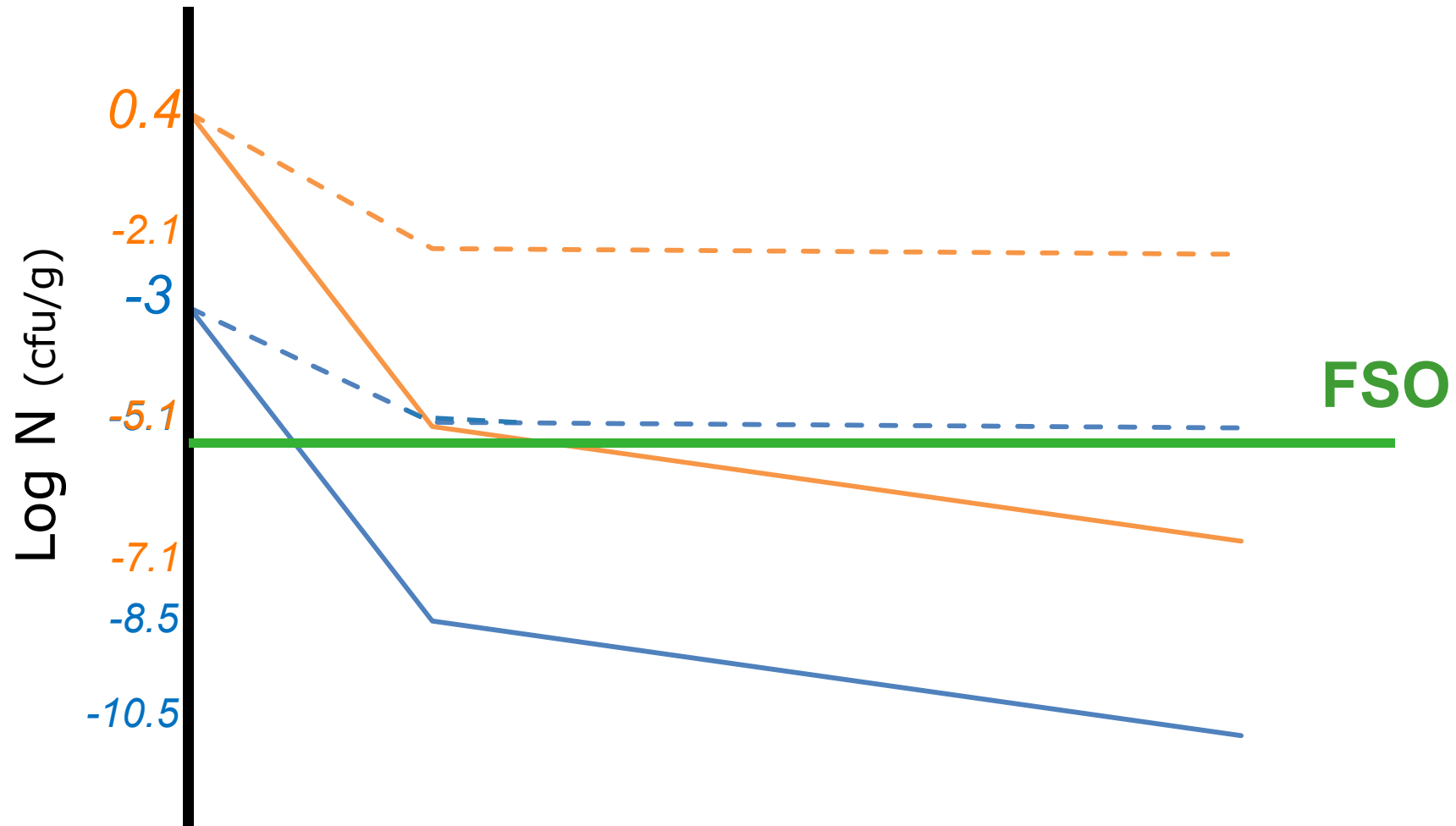


FSO Factors- $\Sigma R_{\text{tenacity}}$

- $\Sigma R_{\text{tenacity}} \rightarrow$ Survival in storage conditions
- Tenacity Factors: Spores, Gram stain
 - Log D_{surv} spores: 2.9(PI \pm 0.7) log days=2.3 years
 - Log D_{surv} vegetative: 2.2(PI \pm 1.3) log days=0.5 years
- 20 °C, 0.46 aw
- Storage of paprika: 1 year $\rightarrow \sim$ -2 log cfu/g



Salmonella spp. in Paprika Powder



Conclusions

- Framework for quantification of control in the spice/herb chain
- Determined the effect of variability factors
- Scenario analysis

Acknowledgments

- Jen Banach
- Tom Kim Dongmin
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- FUCHS



Thank you for your attention

Questions?



ALOP-FSO

Mortality rate *Salmonella*=0.78%

Ill=death/mortality rate=1/0.0078=128

Ill p.p/p.d.=r*Dose=r*average consumption*concentration

R=0.0075

Ill p.y/population=ill*365*10⁸

Average consumption=weight*portions=1.8/16=0.11g

Concentration=10^{FSO}

FSO=log(ill/r*avcon*365*10⁸)=log(128/0.11*365*10⁸)

=-5.4 log cfu/g

Factors

Levels = prevalence of 0.03 equals to 3 positive (1 cfu present) in 100 samples,

if 25g per sample then $3\text{cfu}/2500\text{g}=0.0012=-3\log \text{cfu/g}$

Irradiation= $-0.55*10=-5.5 \log \text{cfu/g}$

Storage= $2.39-0.0055*20=2.28 \text{ Log D}$

D=190 days 1 log reduction for 365 days=1.92 log cfu/g reduction

Thermal

