



Risk Assessment Modeling of *Salmonella* in Almonds

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Danyluk, Harris, and Schaffner, 2006. *JFP* 69:1594-1599

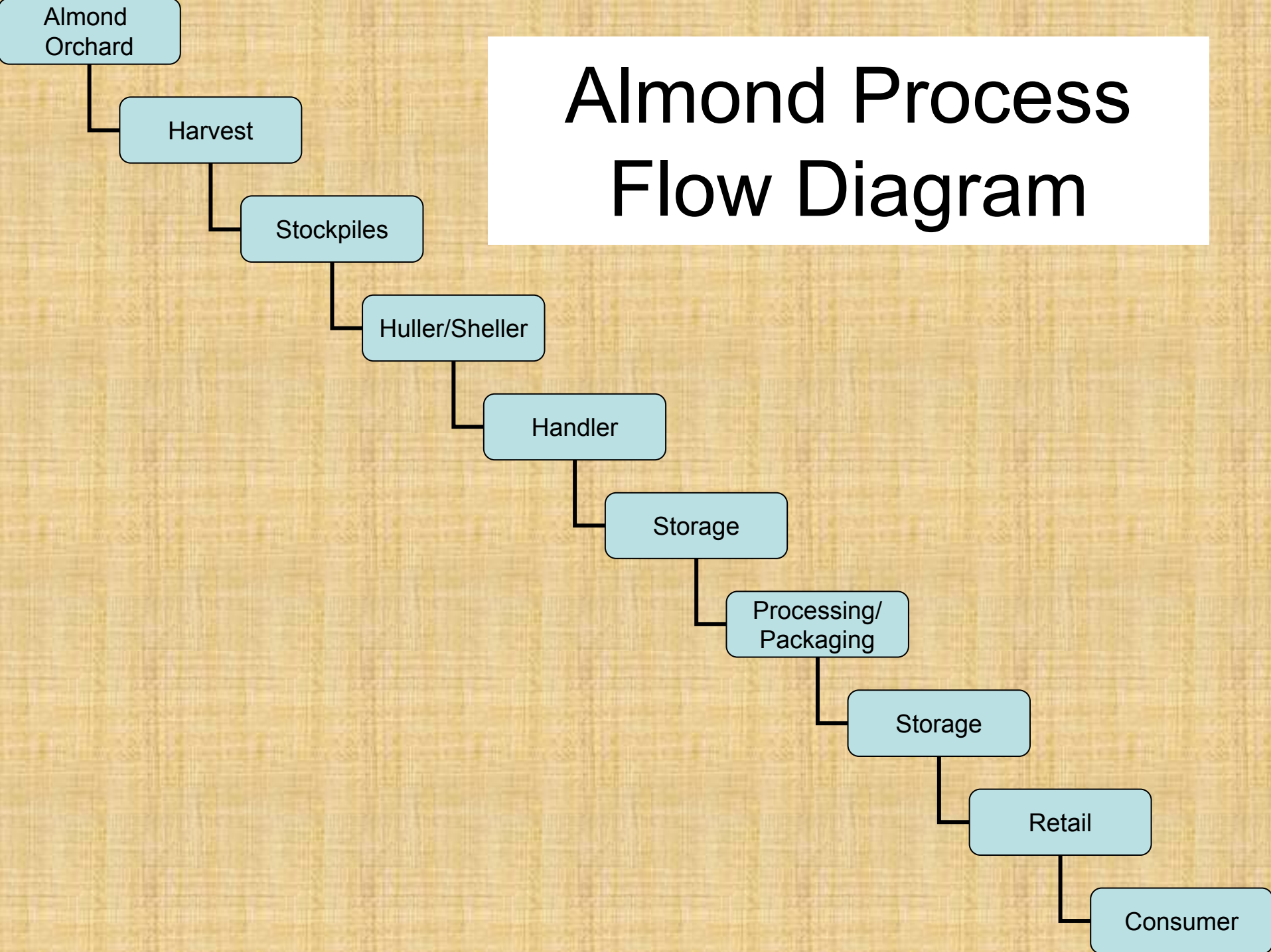


Objectives

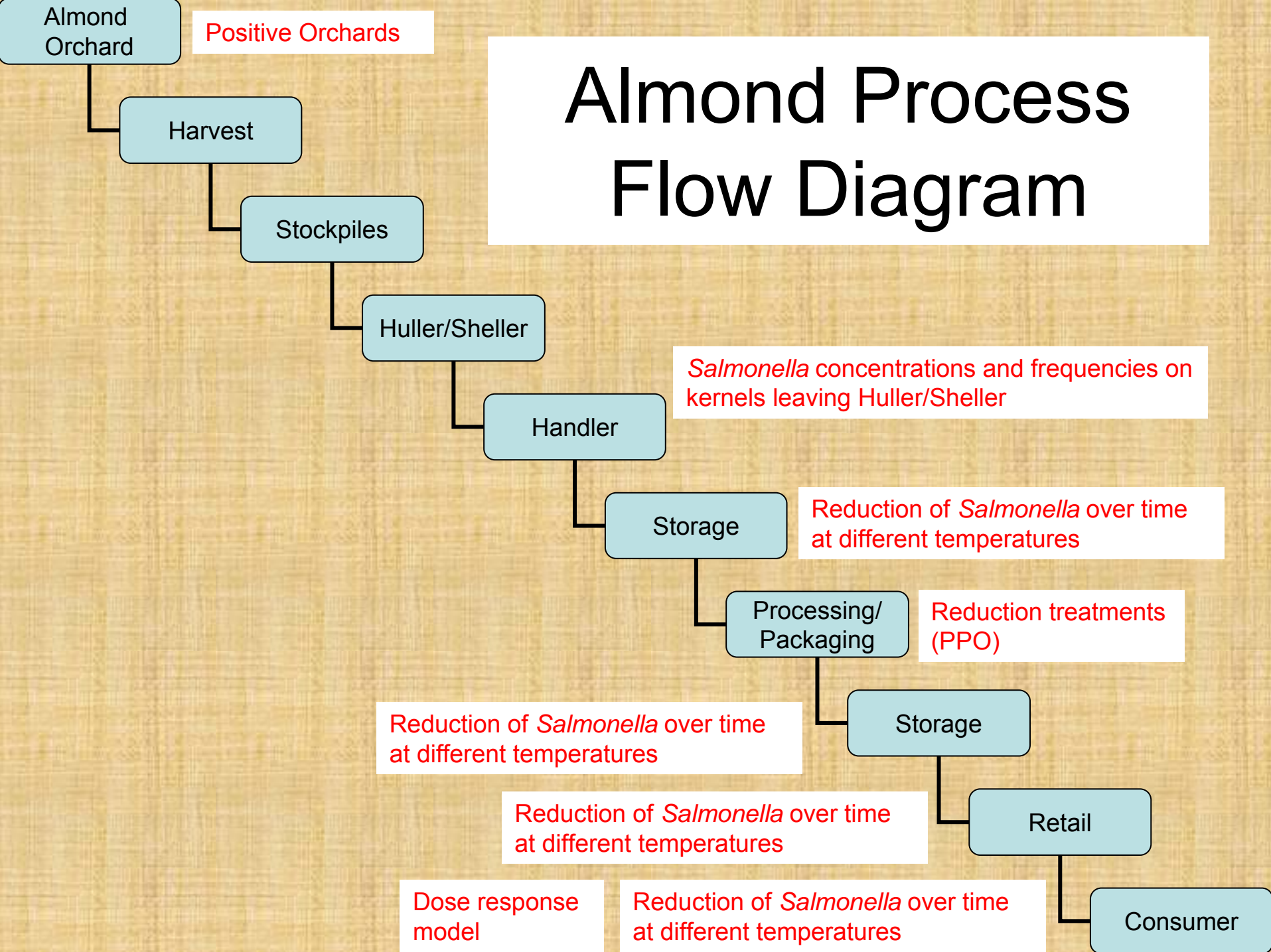


1. Estimate the risk of salmonellosis from consumption of raw almonds in the U.S.
2. Evaluate the reduction of salmonellosis after application of process with different levels of process control

Almond Process Flow Diagram

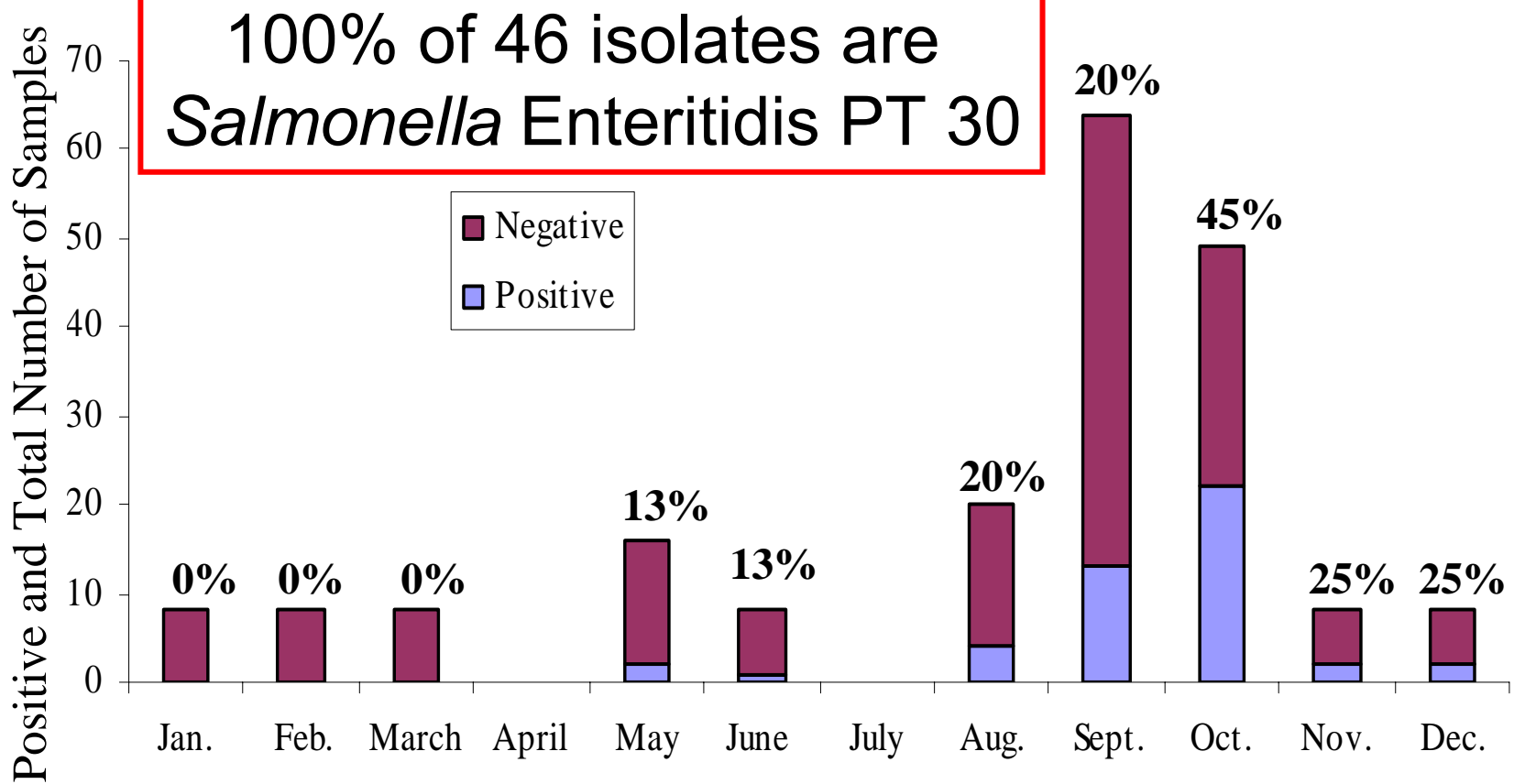


Almond Process Flow Diagram



Salmonella positive fields

Isolation from a single almond orchard from
2002-2005
(224 pooled swabs)



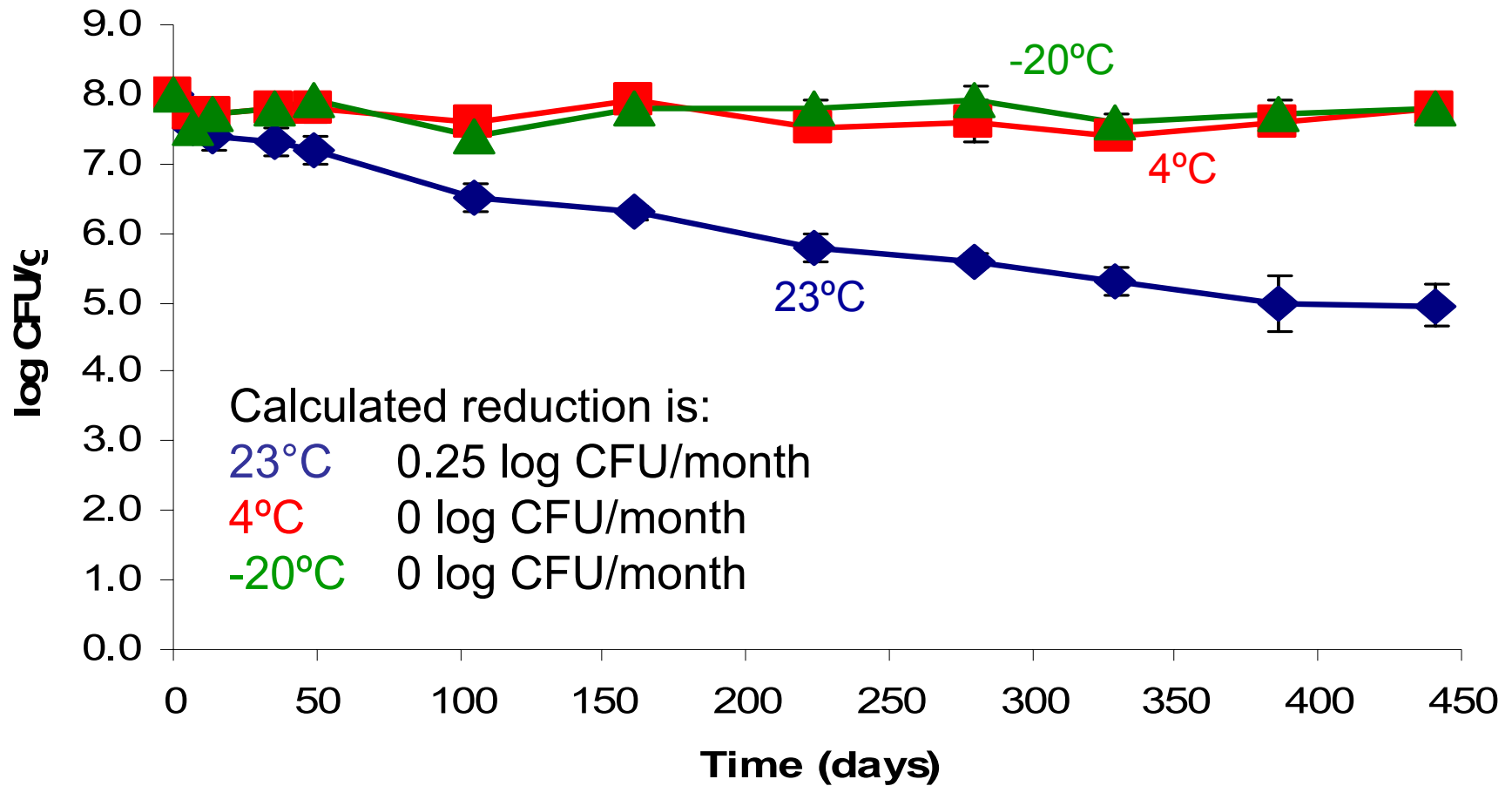
Salmonella concentrations and frequencies on kernels leaving Huller/Sheller

Survey of Almonds from Huller/Sheller (100 g)

Year	Number Positive	% Positive	MPN/100 g	Number MPN >1.2 /100 g
2000	42 of 50	84	6.1 – 9.6	4 of 4
2001	12 of 2003	0.60	Not done	Not done
2002	24 of 2012	1.2	<1.2 - 2.9	1 of 24
2003	15 of 1764	0.80	<1.2 - 1.4	3 of 15
2004	12 of 1643	0.73	<1.2 - 1.4	1 of 12
2005	18 of 1852	0.97	<1.2 - 1.4	1 of 18

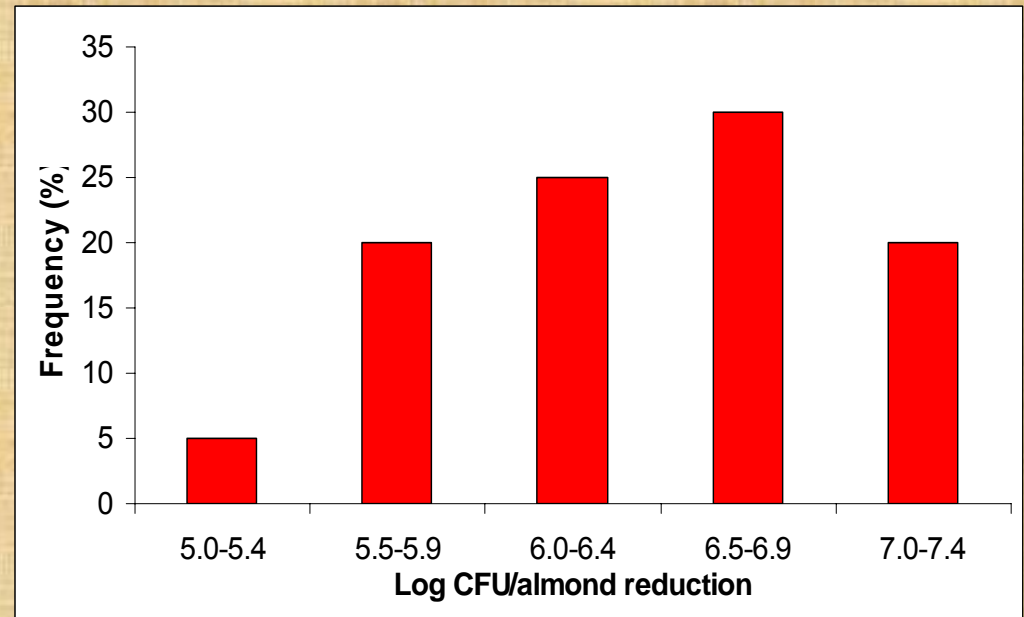
Average 0.87% positive samples per year

Reduction of *Salmonella* over time at different temperatures



Reduction treatments (PPO)

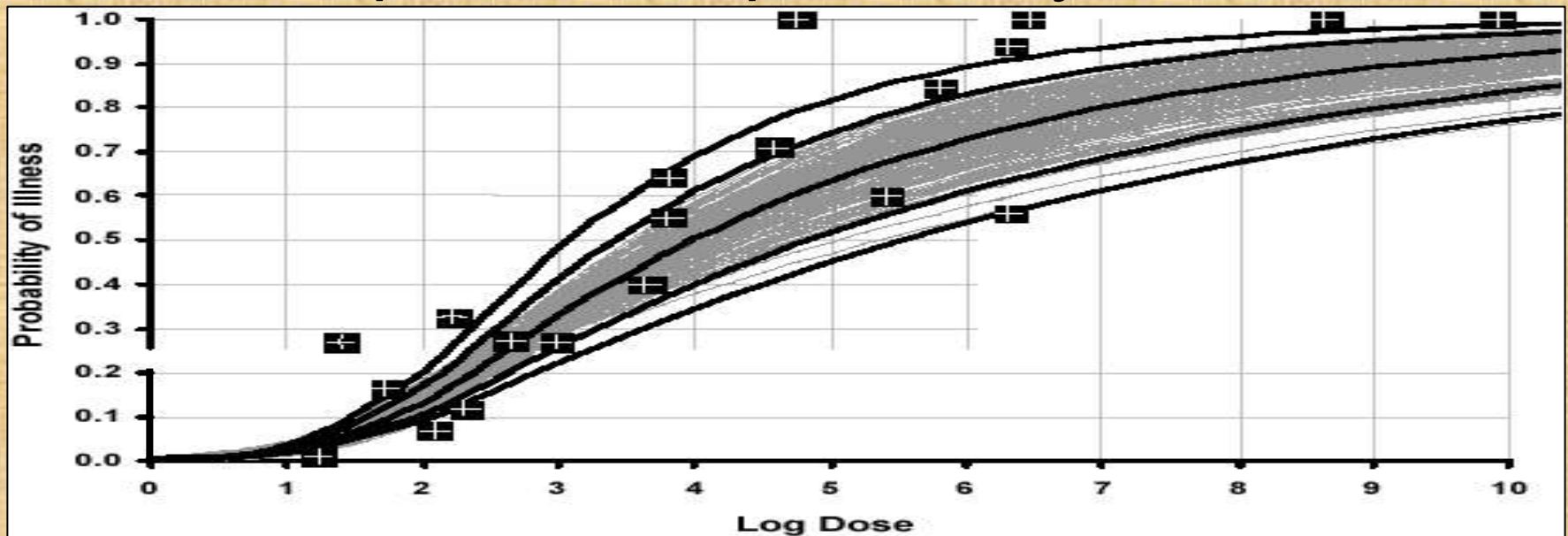
PPO represents a “real world” treatment, that is not a uniform distribution and has a relatively high standard deviation.



Distribution of *Salmonella* Enteritidis PT 30 reduction on almonds following treatment with propylene oxide. Adapted from Danyluk et al. 2005.

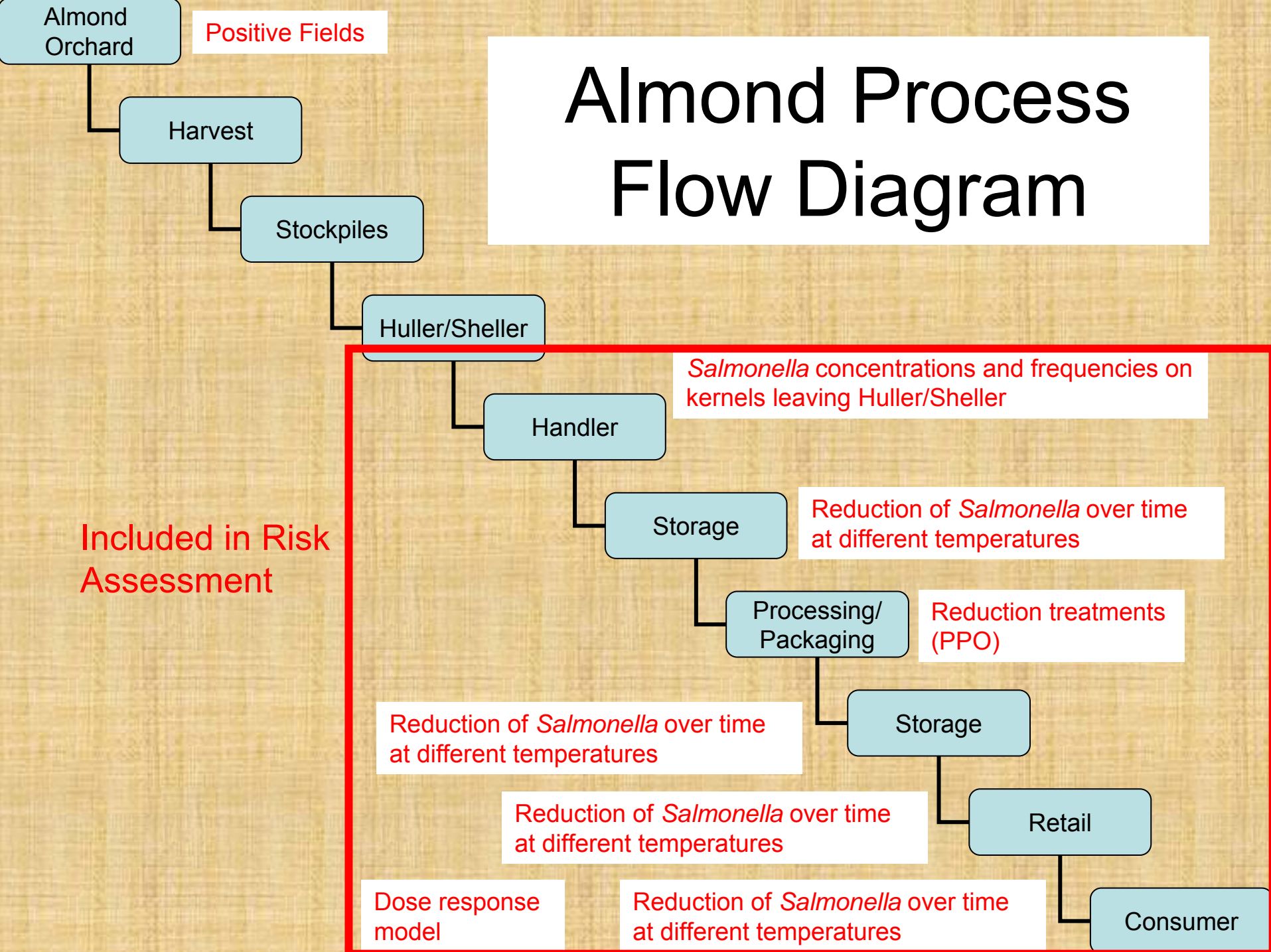
Dose response model

- In order to predict disease, a dose response model (β -Poisson distribution) from FAO/WHO (2002) for *Salmonella* was used to predict the probability of illness



β -Poisson Dose-Response model for *Salmonella* spp. FAO, 2002.

Almond Process Flow Diagram



Huller/Sheller

Handler

Salmonella concentrations and frequencies on kernels leaving Huller/Sheller

Amount of almonds consumed raw

Storage

Reduction of *Salmonella* over time at different temperatures

Time and temperature of storage

Processing/
Packaging

Reduction treatments (PPO)

Time and temperature of storage

Reduction of *Salmonella* over time at different temperatures

Storage

Time and temperature of storage

Reduction of *Salmonella* over time at different temperatures

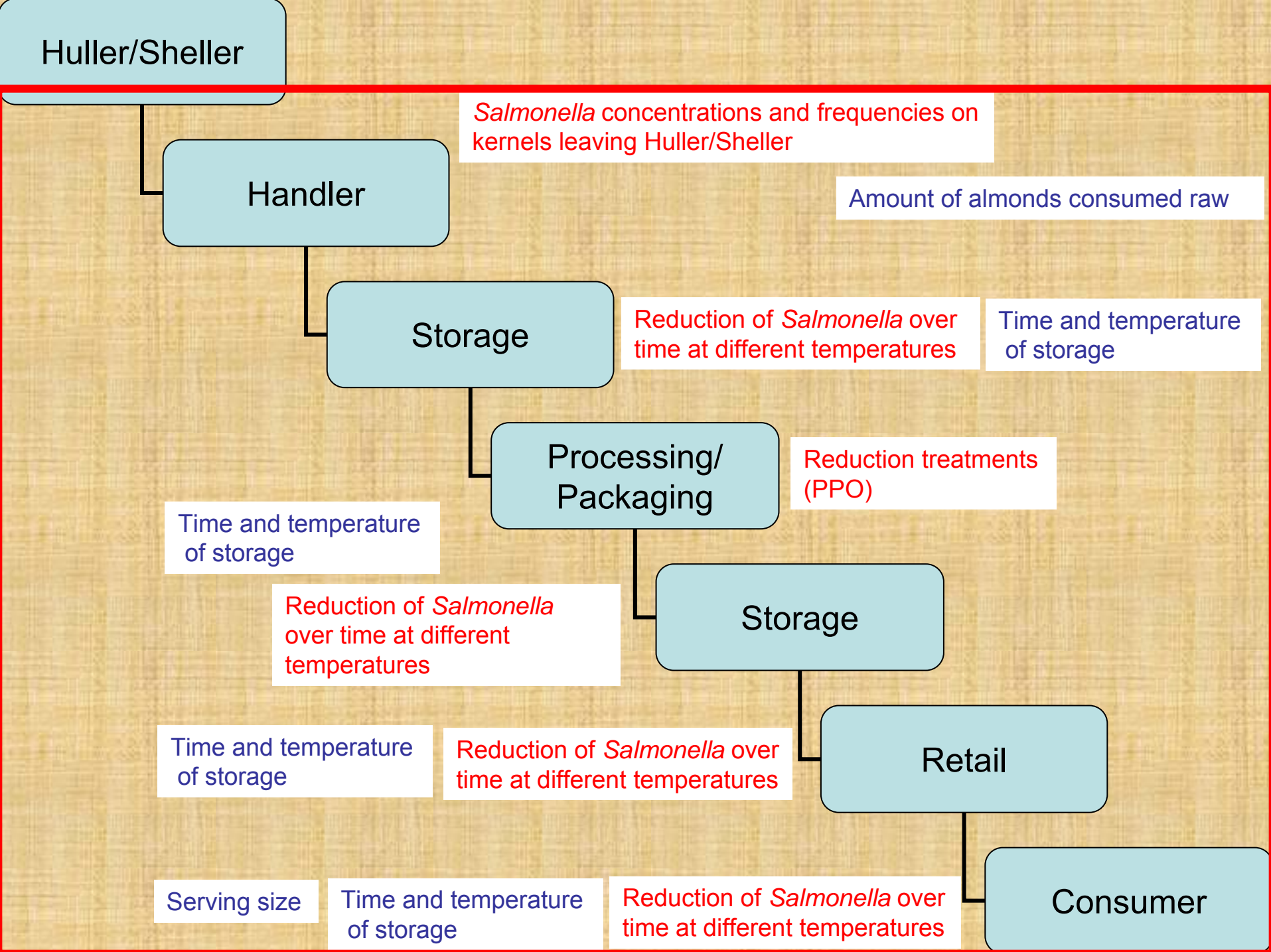
Retail

Serving size

Time and temperature of storage

Reduction of *Salmonella* over time at different temperatures

Consumer



Model

Initial level of *Salmonella*

–

Estimated Reduction

=

{ Pre-process
+
Process
+
Post-process
+
Retail
+
Consumer }

= **Salmonella concentration
per serving**

× Dose Response model

= **Probability of illness per
serving** **×**

**Servings consumed
containing *Salmonella* spp.**

US Consumption of raw almonds

(28-g servings)

×

Positive subsamples

=

**Servings consumed
containing *Salmonella* spp.**

= **Predicted illness per year**

Almond Process Flow Diagram

