



Inactivation of *Escherichia coli* in apple juice of different pH using ozone

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Rationale

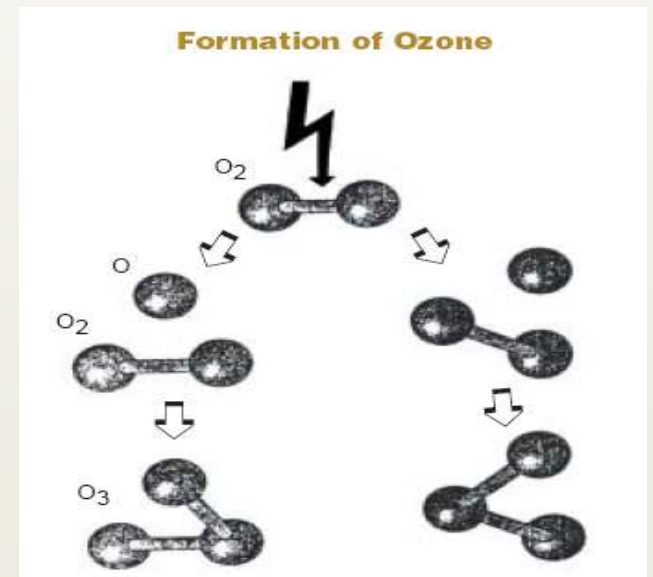
- *E. coli* O157:H7 – acid resistance
- Food borne outbreaks
- Risk
- USFDA - 5 log reduction of pathogens
- USFDA - Ozone direct additive



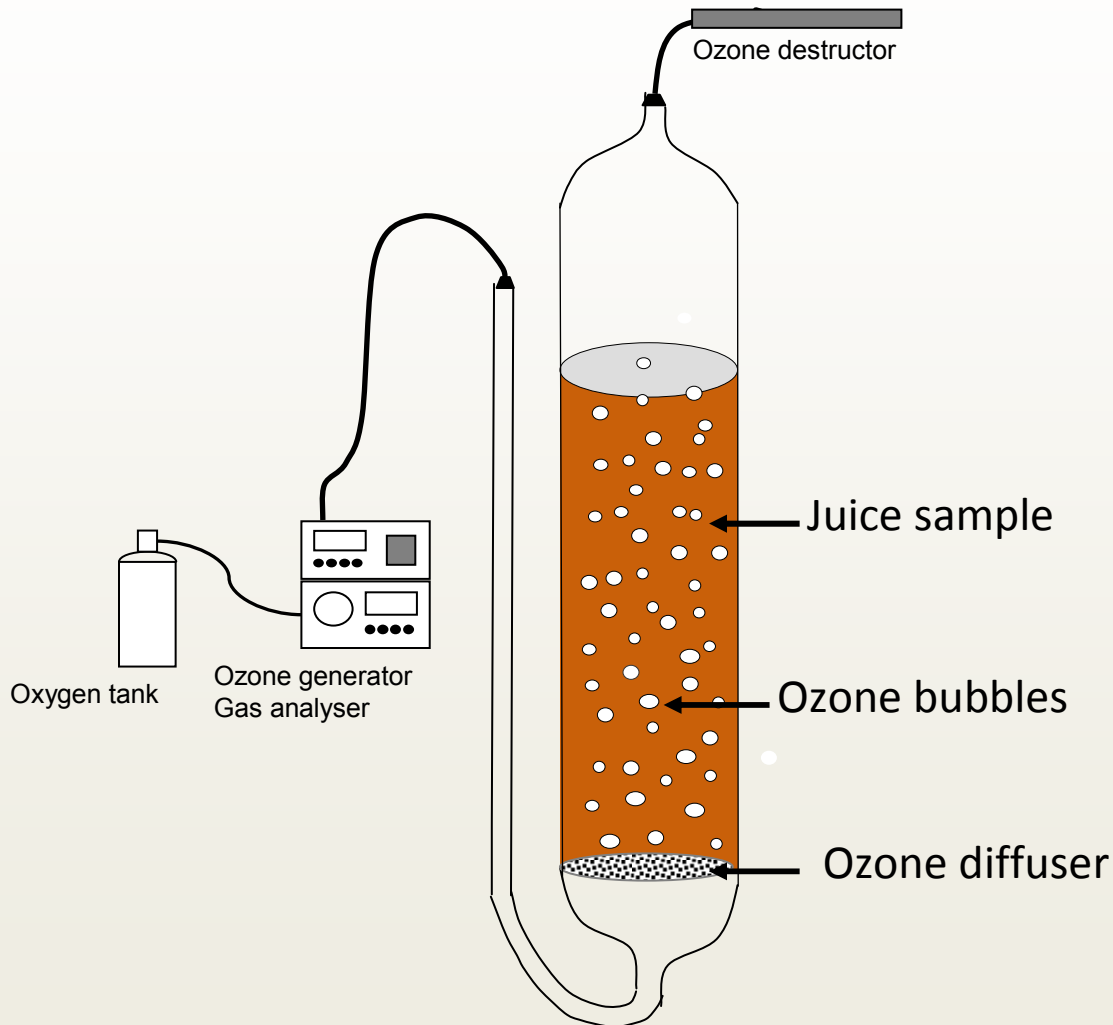


Ozone

- Ozone- strong oxidizing agent, GRAS & effective sanitizer
- Advantage- rapid decomposition
- Mechanism of inactivation- molecular ozone or free radicals



Ozone bubble column



- ❖ *E. coli* strains: ATCC 25922 & NCTC 12900
- ❖ Apple juice: pH levels (3.0, 3.5, 4.0, 4.5 & 5.0)
- ❖ Ozone treatment-
flow rate 0.12L/min &
concentration 33-40
 $\mu\text{g}/\text{mL}$ for up to 18 min

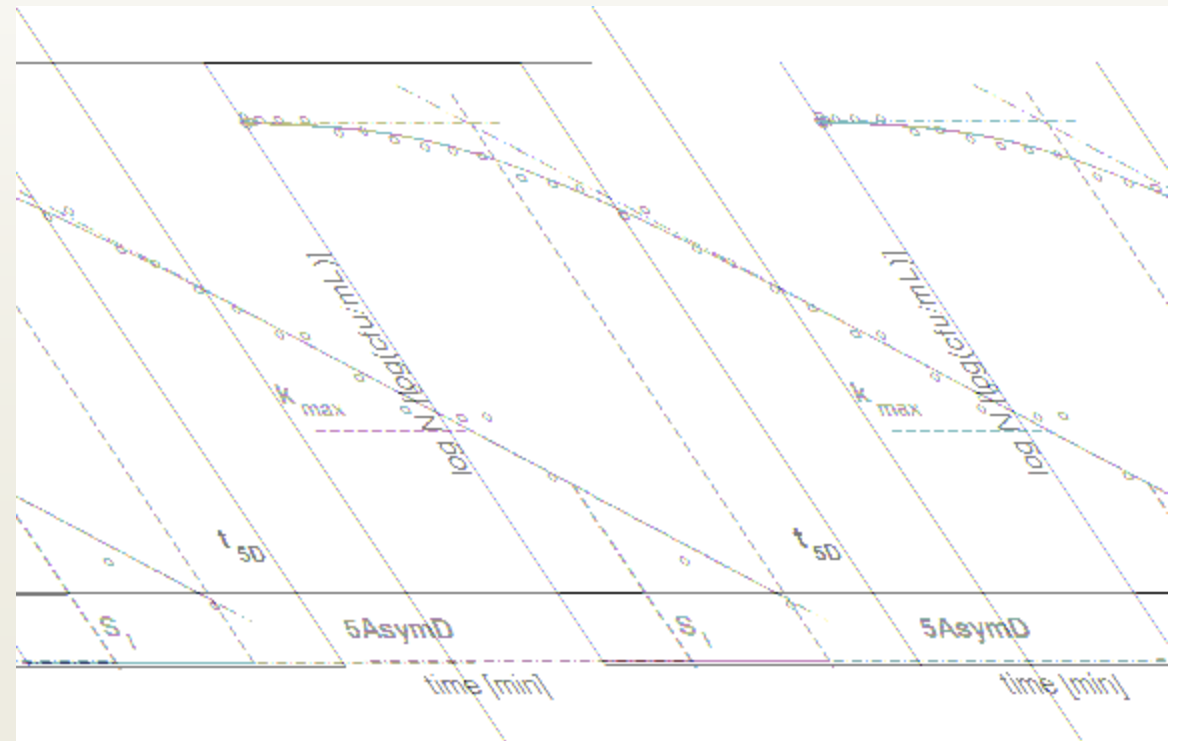


Inactivation kinetics

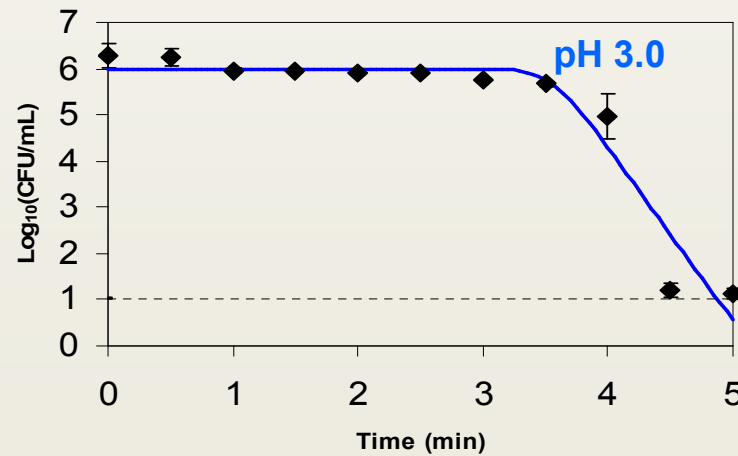
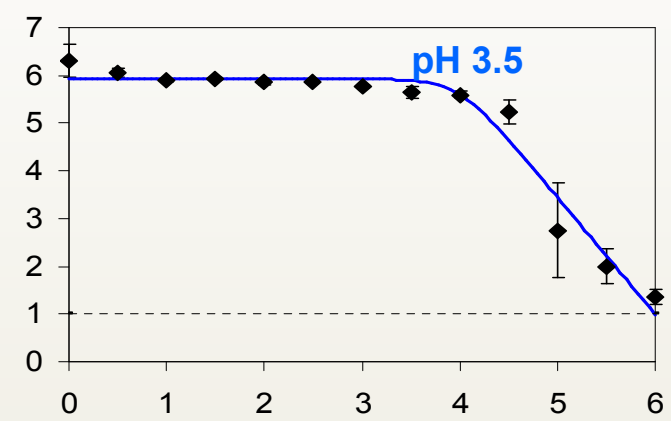
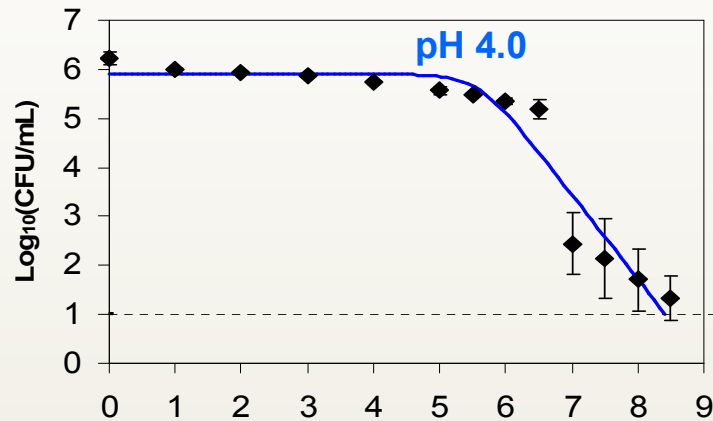
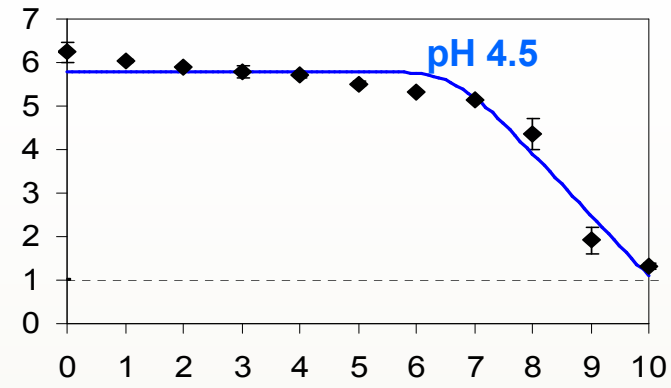
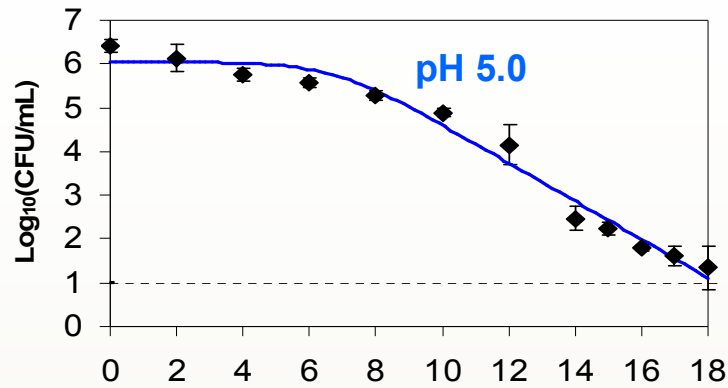
The shoulder-log linear model (Geeraerd et al., 2000; Valdramidis et al., 2005)

$$\log_{10}(N) = \log_{10}(N_0) - \frac{k_{\max} \times (t)}{\ln(10)} + \frac{\log_{10} e^{(k_{\max} \times Sl)}}{(1 + e^{(k_{\max} \times Sl)} - 1)} \times e^{(-k_{\max} \times t)}$$

$$t_{xd} = Sl + (x) \times \frac{\ln(10)}{k_{\max}}$$



Ozone inactivation of *E. coli* NCTC 12900





Strain	pH	Weibull model	RMSE	Shoulder log linear	RMSE
ATCC 25922	5.0	17.37 ± 1.92 ^{a*}	0.20	18.15 ± 0.71 ^{a*}	0.23
	4.5	10.07 ± 2.17 ^b	0.46	10.34 ± 0.57 ^b	0.37
	4.0	8.10 ± 1.11 ^c	0.53	8.28 ± 0.55 ^c	0.46
	3.5	5.27 ± 0.70 ^d	0.49	5.36 ± 0.74 ^d	0.44
	3.0	4.30 ± 0.99 ^d	0.74	4.01 ± 2.93 ^d	0.43
NCTC 12900	5.0	17.41 ± 3.03 ^a	0.31	18.16 ± 0.96 ^a	0.31
	4.5	10.37 ± 1.84 ^b	0.47	10.21 ± 0.65 ^b	0.37
	4.0	8.31 ± 1.18 ^c	0.62	8.48 ± 0.69 ^c	0.50
	3.5	5.99 ± 0.67 ^d	0.46	6.03 ± 0.69 ^d	0.35
	3.0	4.88 ± 0.66 ^e	0.68	4.88 ± 1.62 ^e	0.55



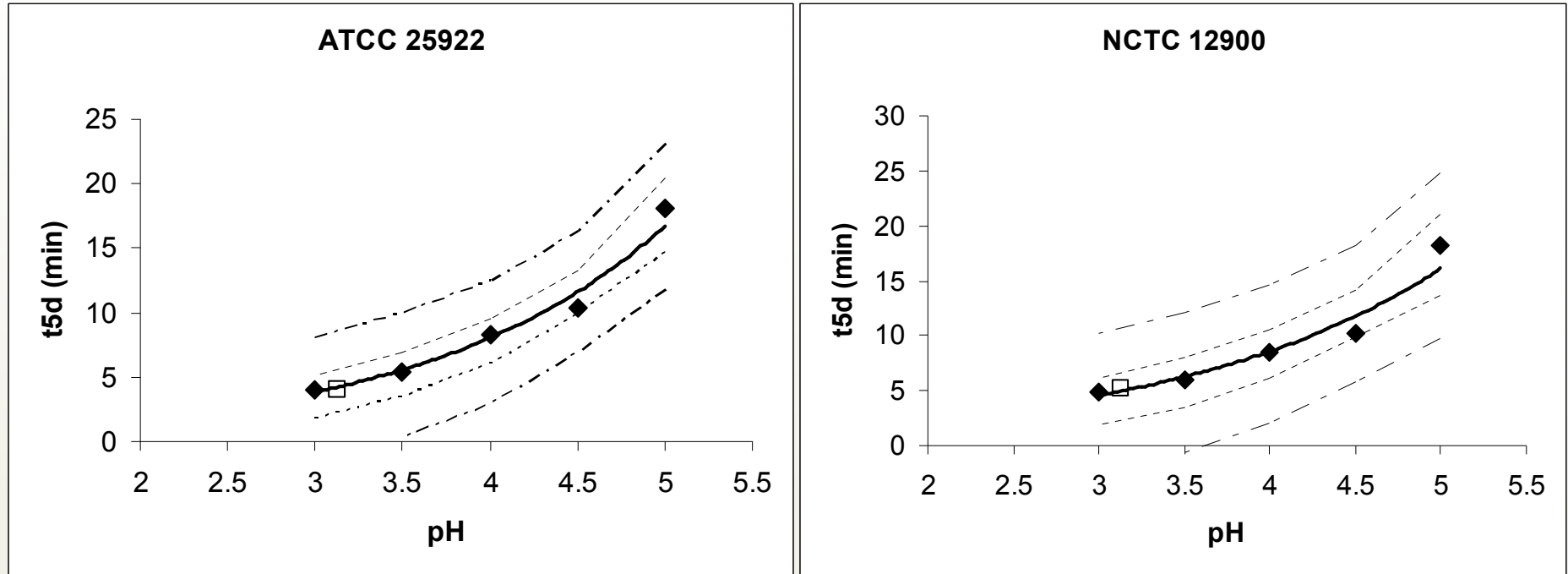
A correlation was established between the t_{5d} and the different adjusted pH levels of apple juice.

Exponential equation:

$$t_{5d} = a \times e^{k \times pH}$$

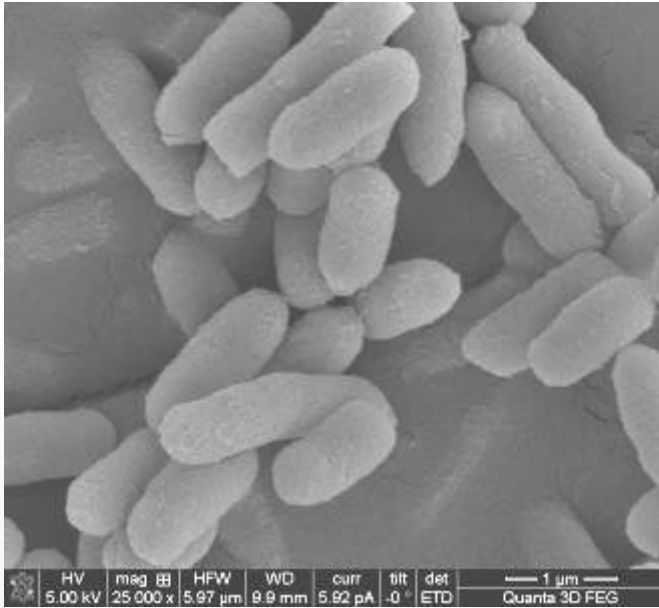


Correlation

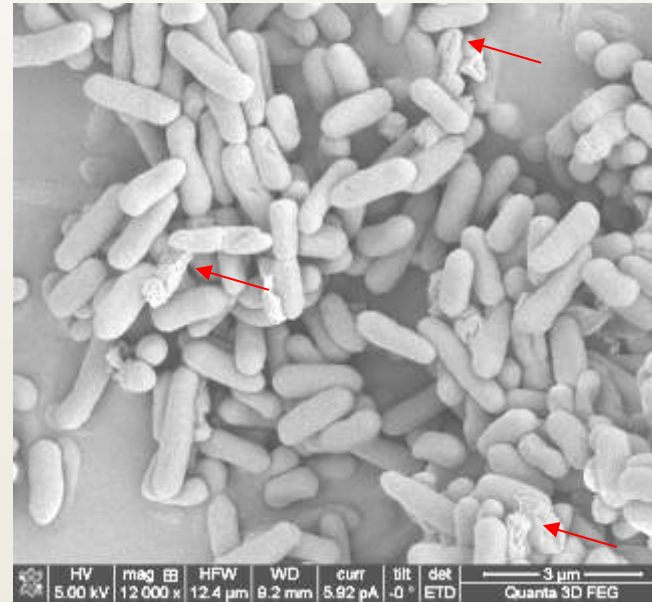
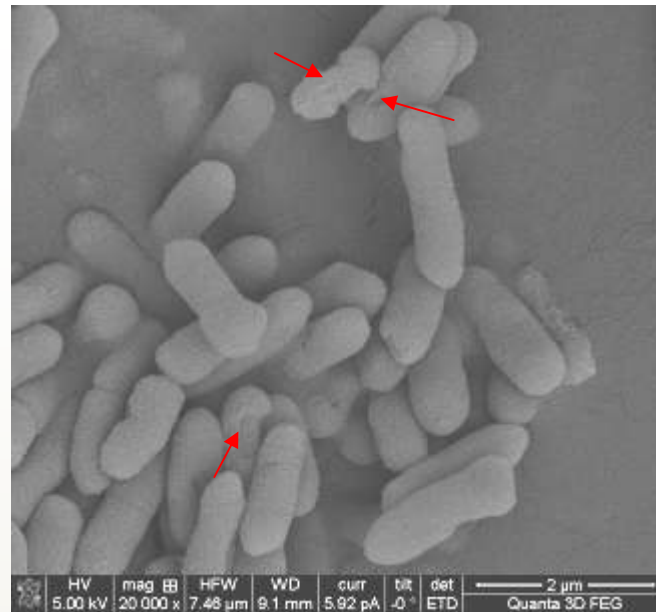


. (-): fit, (- -): 95 % prediction bounds, (- · -): 95% confidence bounds. (□) Validation point, (◆) Observed data values

Untreated



Ozone treated





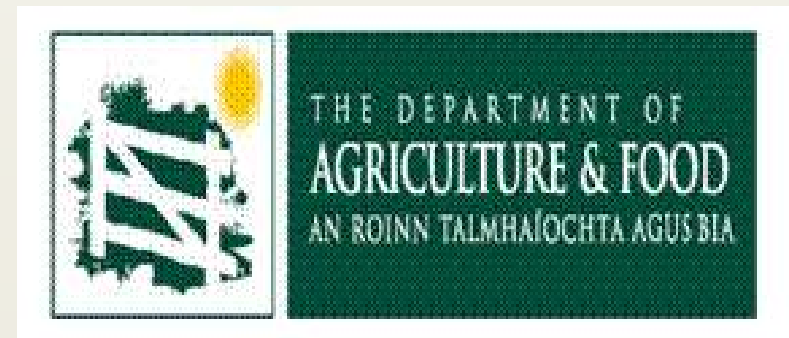
Conclusions

- Direct ozone treatment- inactivate *E. coli* in apple juice.
- Efficacy of ozone treatment – a function of pH of the apple juice.
- Inactivation by 5 log cycles- 4.0 to 18.16 min.
- Good degree of correlation between t_{5d} and pH in apple juice can be applied to design treatment time period.
- Further studies - effect of ozone on sensory and nutritional quality.



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Thank you

