Sous Vide Food Safety

REDUCED OXYGEN PACKAGING

WHY SV?

SV → serve
Bulk food prep
Allergen-free prep
Culinary $$$$

- Trap juice/fat, ⇣ washout
- Keep items from falling apart
- Remove oxygen (ROP)
  reduce oxidation
  - ↓ *color changes*
  - ↓ *flavor changes*
- Cook at a precise temp
  - HTST (high temp-short time)
  - LTLT (low temp – long time)

Retail-Foodservice Food Safety Consortium

Crispy Duck Confit

SV-hot hold-serve

Octopus (usually HTST)

The incredible edible EGG

Ambient steak interior with fully cooked surface

SV - serve

Poultry using USDA cooking charts

Seafood, undercooked

Beef or pork using food code roast cooking charts

4 lb burger cooked thru

72 h ribs

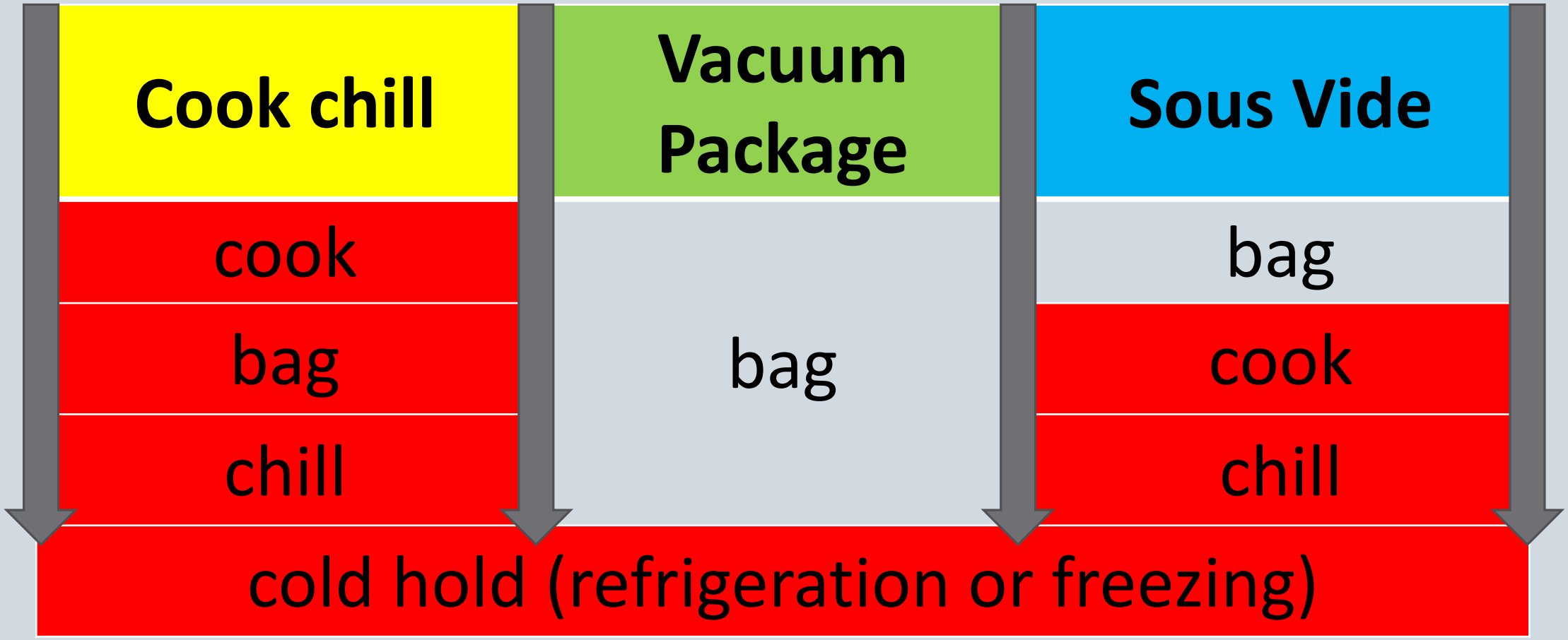
Pasteurize house-made salami

Perfect crust tenderloin


ADCRAFT


ANOVA
130.0
130.0

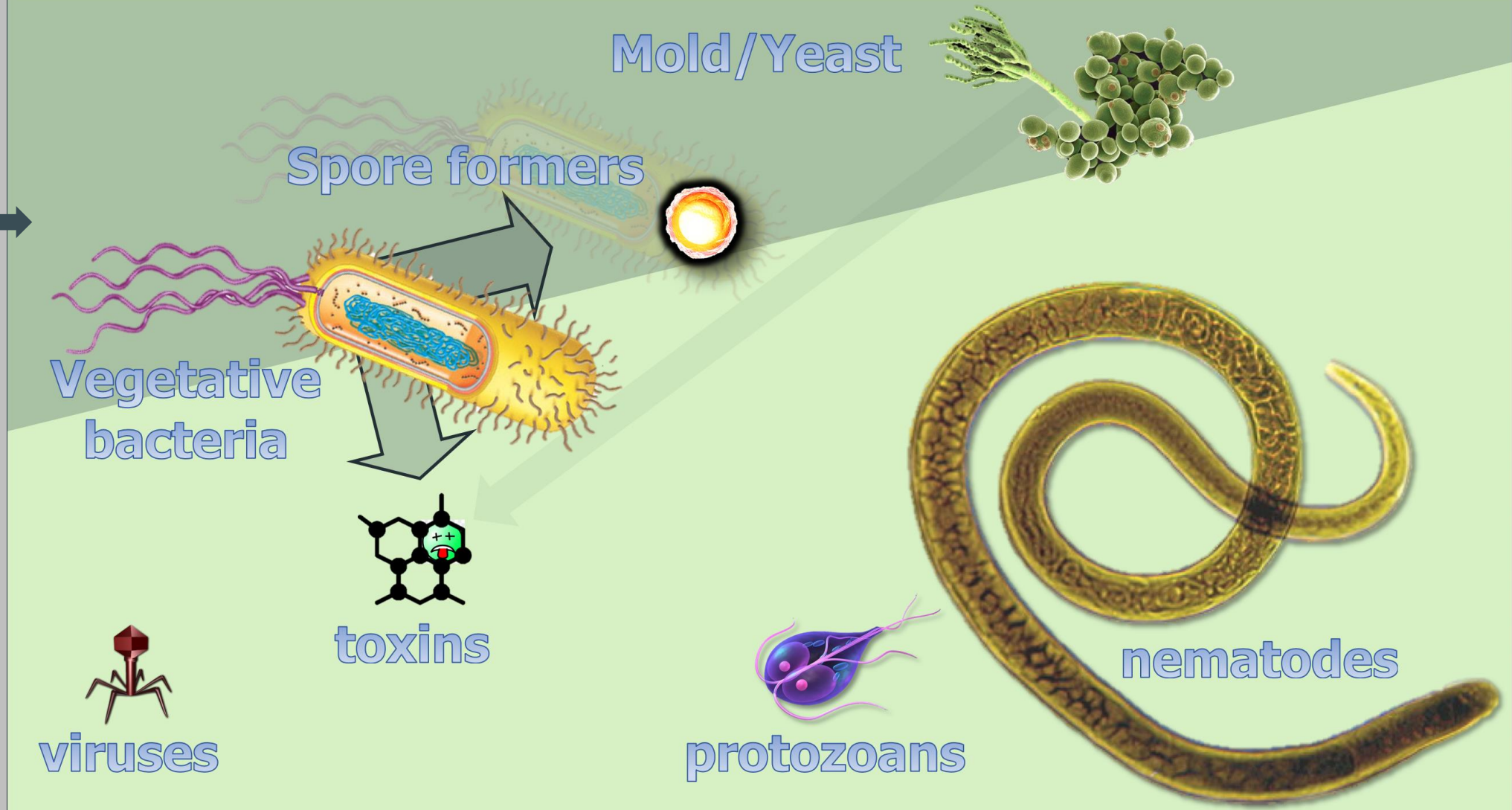
ROP Flow of Food



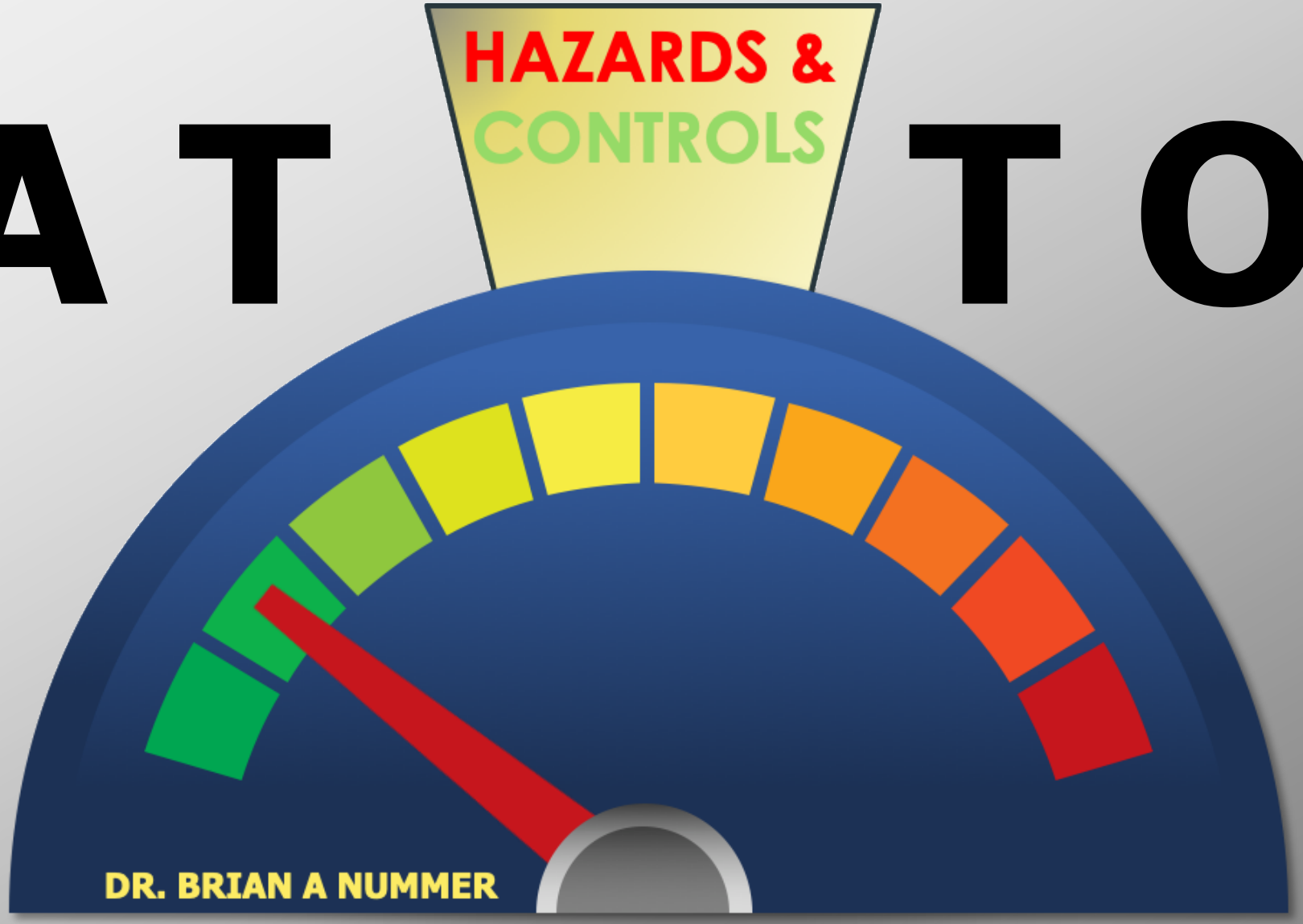
Biological HAZARDS

SV

- VP
- Cook
- Chill
- Cold Hold

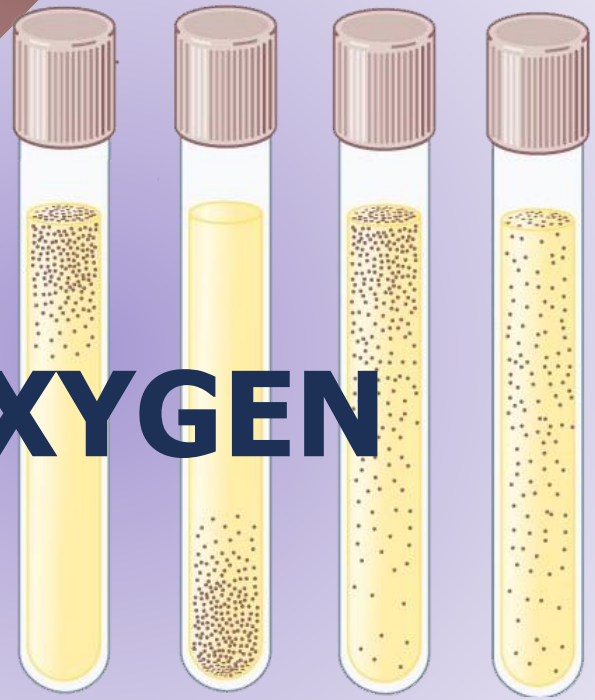


FAT TOM

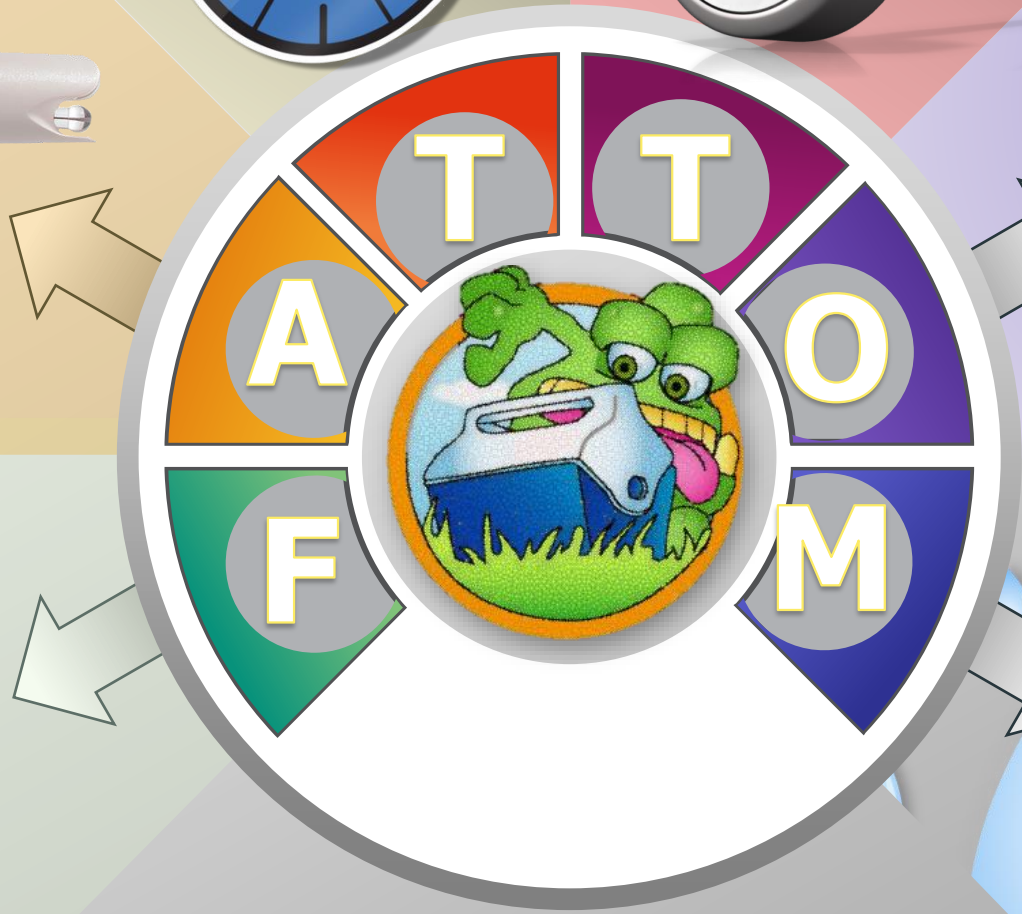


TIME

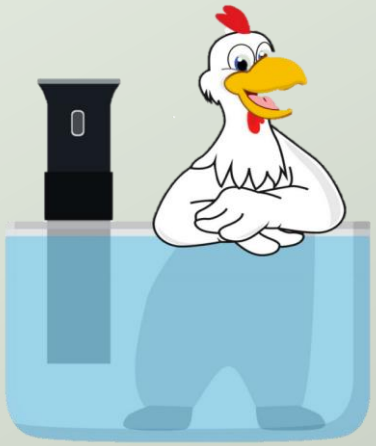
ACID



OXYGEN



FOOD



MOISTURE

People

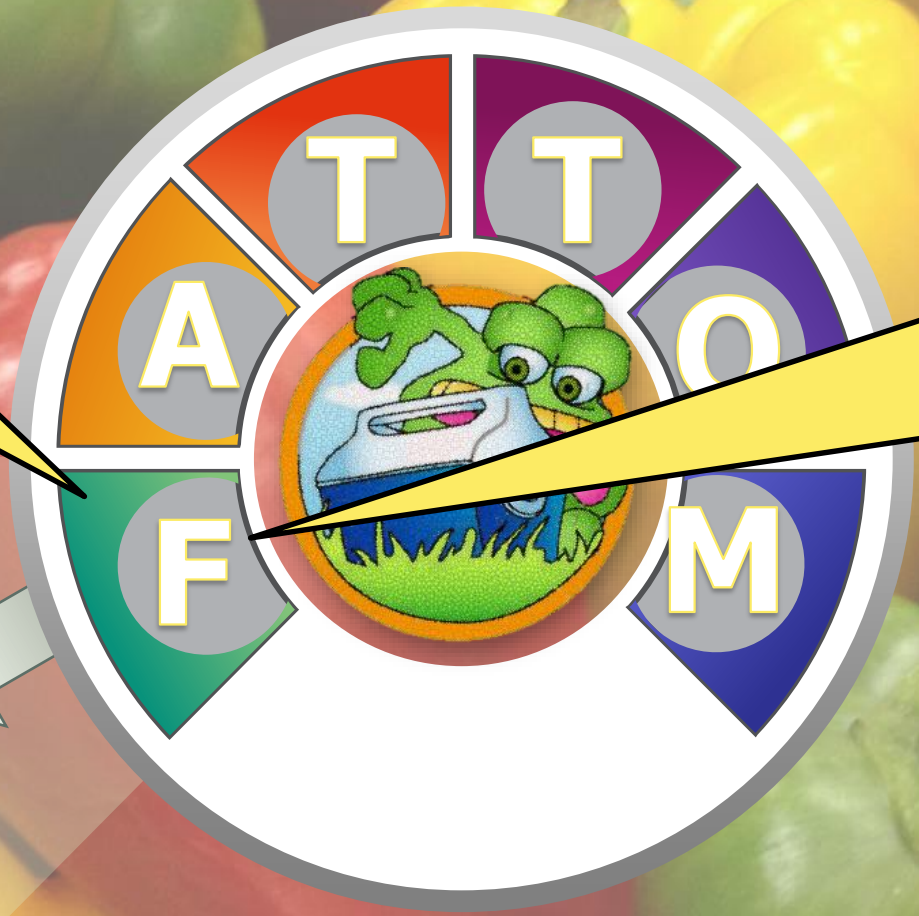
Tools

Process


30
50
80
120
HURDLES
HAZARDS
Growth possible
Very Slow Growth
No growth
No growth or Survival
BARRIERS
PATHOGENS vs SPOILAGE
ELIMINATION
THE FOOD SAFETY CONTROL METER

Microbial Food

carbon source(s)
nitrogen source(s)
Inhibitor(s)

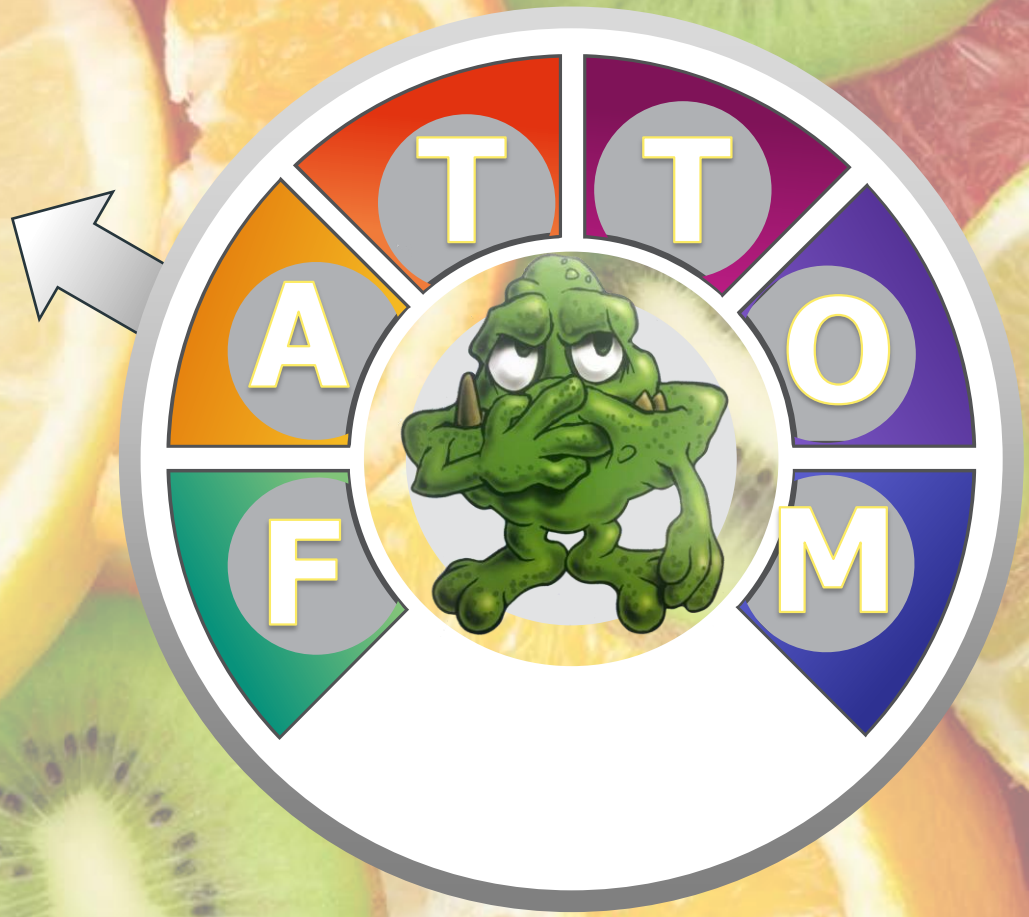


Microbes PRESENT

BACTERIA
YEAST/MOLD
VIRUSES
PARASITES

FOOD

ACIDITY

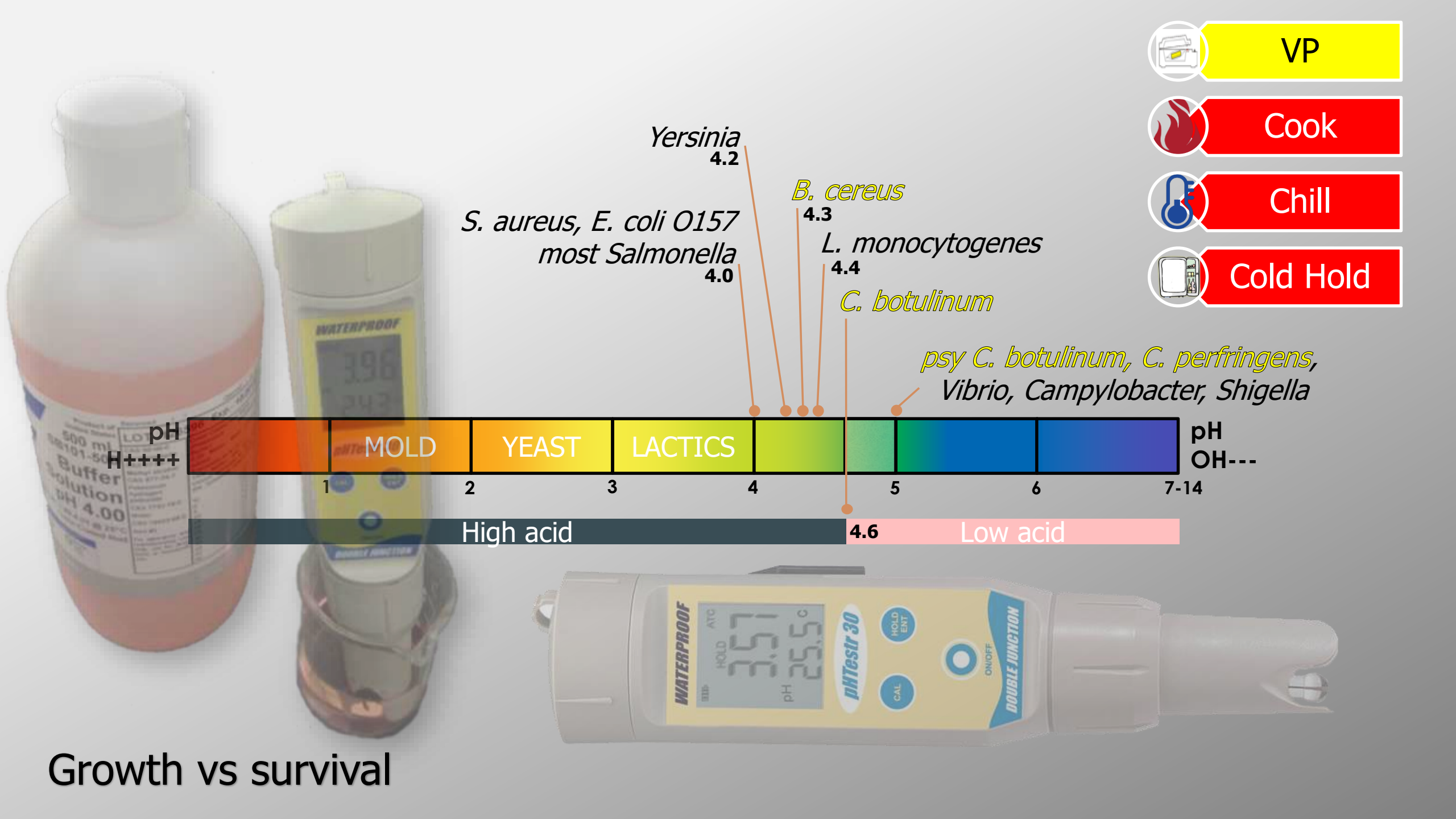


VP

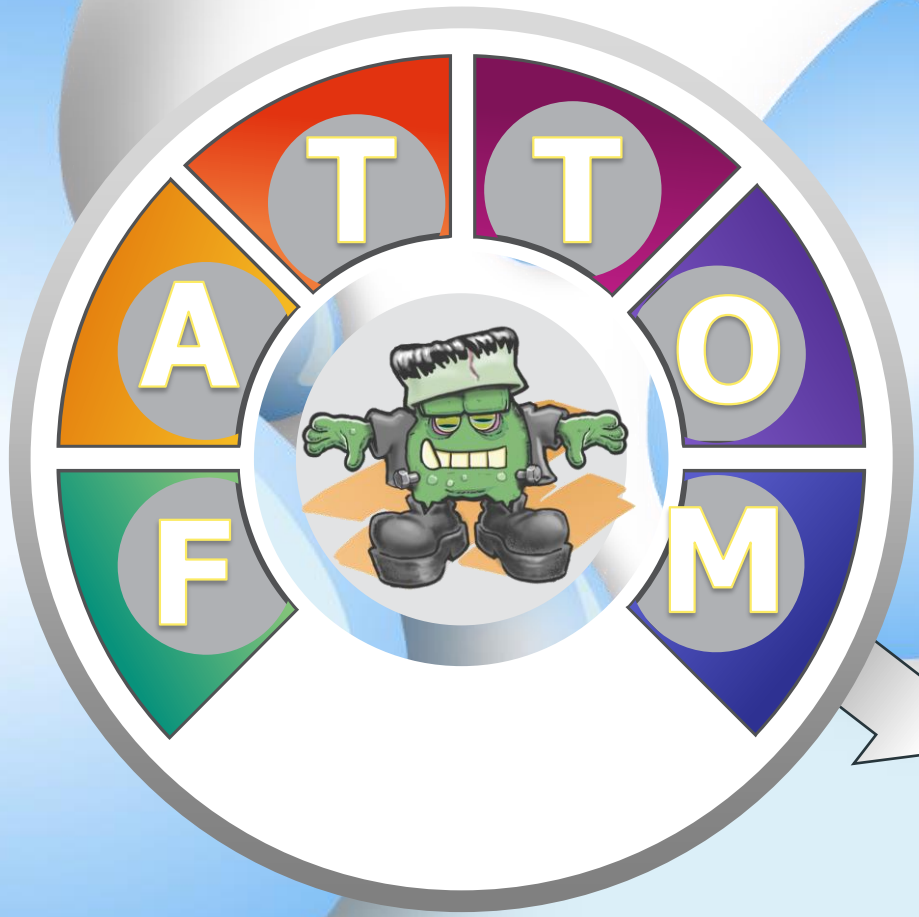
Cook

Chill

Cold Hold



Growth vs survival



MOISTURE

Intermediate moisture foods

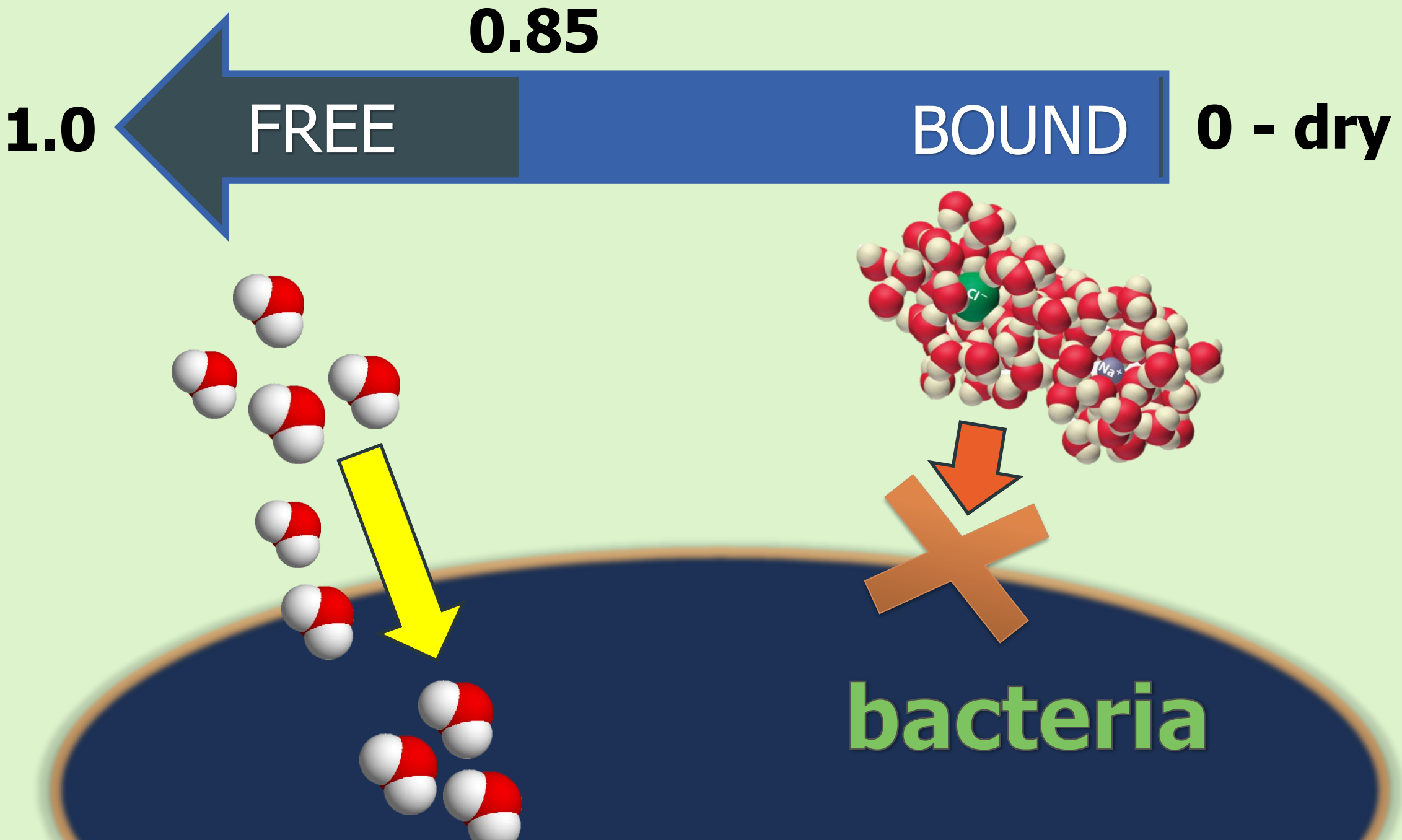
No pathogen growth – spoilage potential

Aw 0.61 (0.7) to 0.85 (0.88)

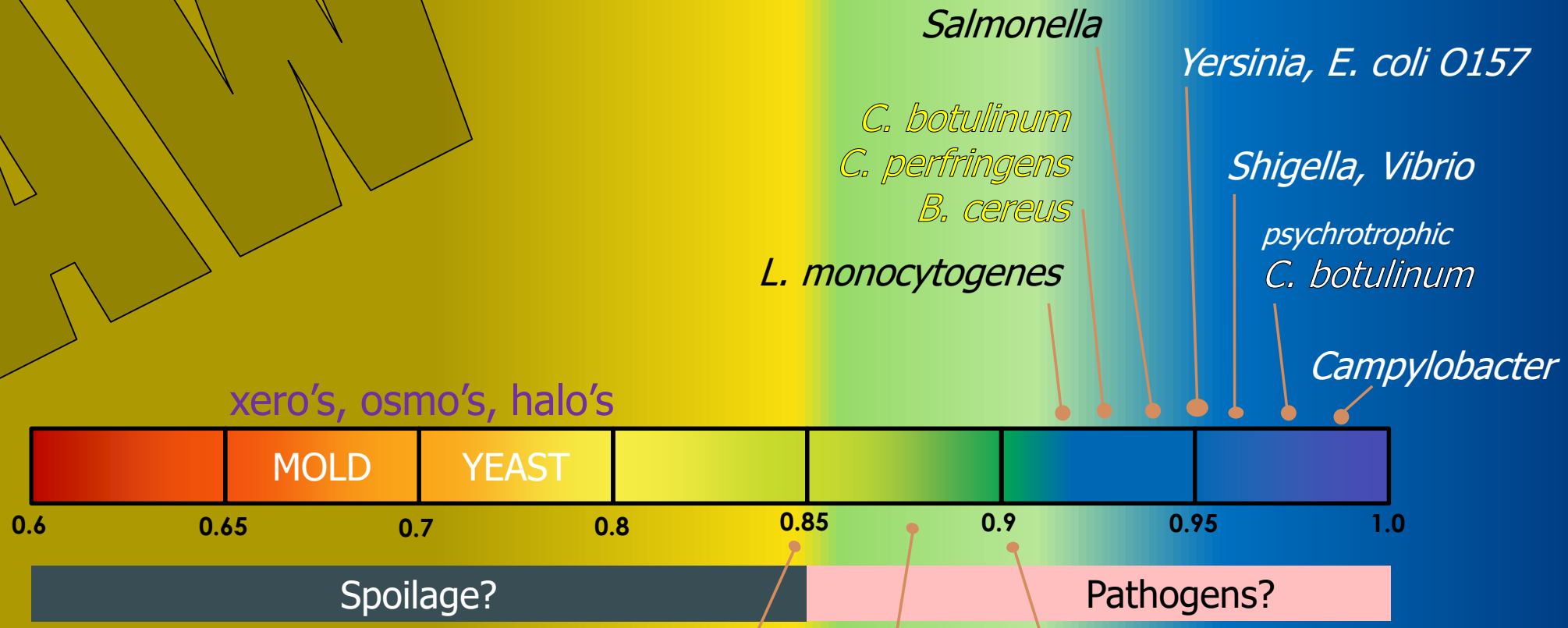
Low moisture foods Aw 0-0.6 (no growth)

High moisture foods Aw 0.86 – 1.0 pathogen growth

Water Activity 0 – 1.0


0.85
1.0
FREE
BOUND
0 - dry
bacteria

A_W



S. aureus
regulatory limit

0.88 toxin limit
aerobic growth

0.90 toxin limit
anaerobic growth

SV

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TABLE A	pH ≤ 4.6	pH 4.6-5.6	pH > 5.6
Aw ≤ 0.92			
Aw 0.92-0.95			
Aw > 0.95			

Non TCS = ROP = no HACCP

SV

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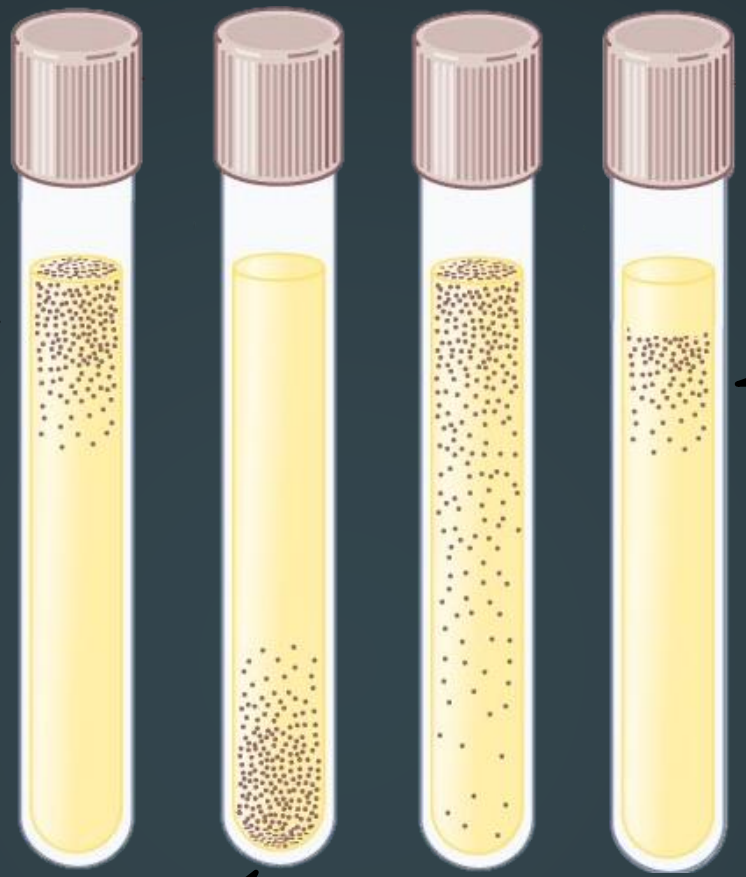
OXYGEN

strict Aerobes
Molds
some *Bacillus cereus*



Micro aerophile
Campylobacter

strict Anaerobes
Clostridium botulinum
Clostridium perfringens

Facultative
Everybody else

SV

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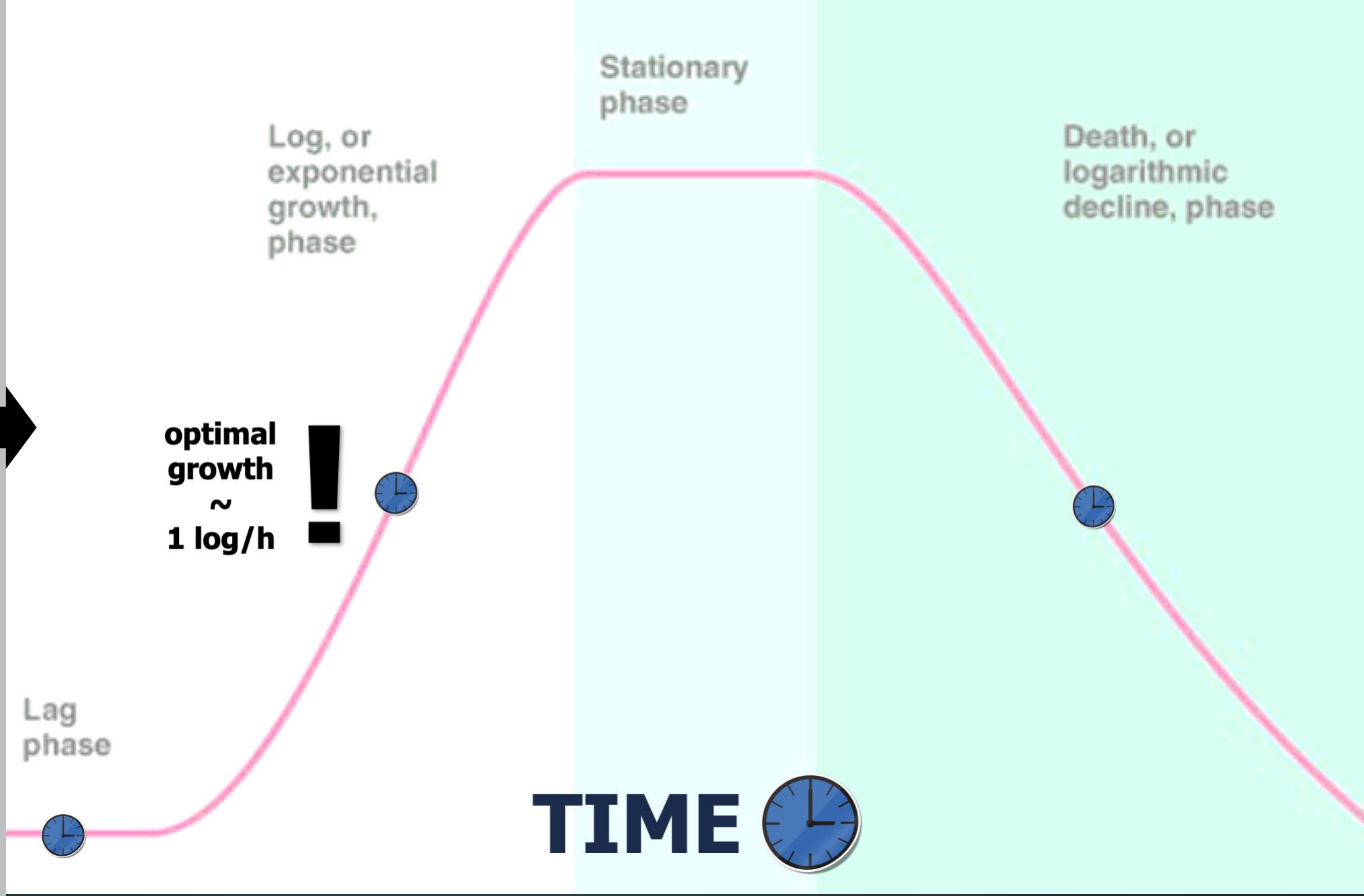

Which biological hazards GROW *in TCS foods?*

SV

Infection, toxicoinfection, or toxin?

Bacillus cereus	*Campylobacter jejuni*	*Clostridium botulinum*	psychrotrophic *Clostridium botulinum*	*Clostridium perfringens*	***Escherichia coli* O157 H7**
Emetic = toxin Diarrheal = toxicoinfection	I	toxin	toxin	toxicoinfection	**I**
Listeria monocytogenes	*Salmonella*	*Shigella*	*Staphylococcus aureus*	Vibrios	***Yersinia enterocolitica***
I	I	I	toxin	I	**I**

1. Will spores [veg. cells] of *B. cereus* or *C. perfringens* cause FBI?
2. Properly cook (reheat) a food that has *B. cereus* or *C. perfringens* veg. cells, is there potential for FBI?
3. Will preformed toxin of *S. aureus*, *C. botulinum*, or *B. cereus* (emetic) cause FBI?
4. For foods that will be thoroughly cooked, which toxin formers are still biological hazards?

SV

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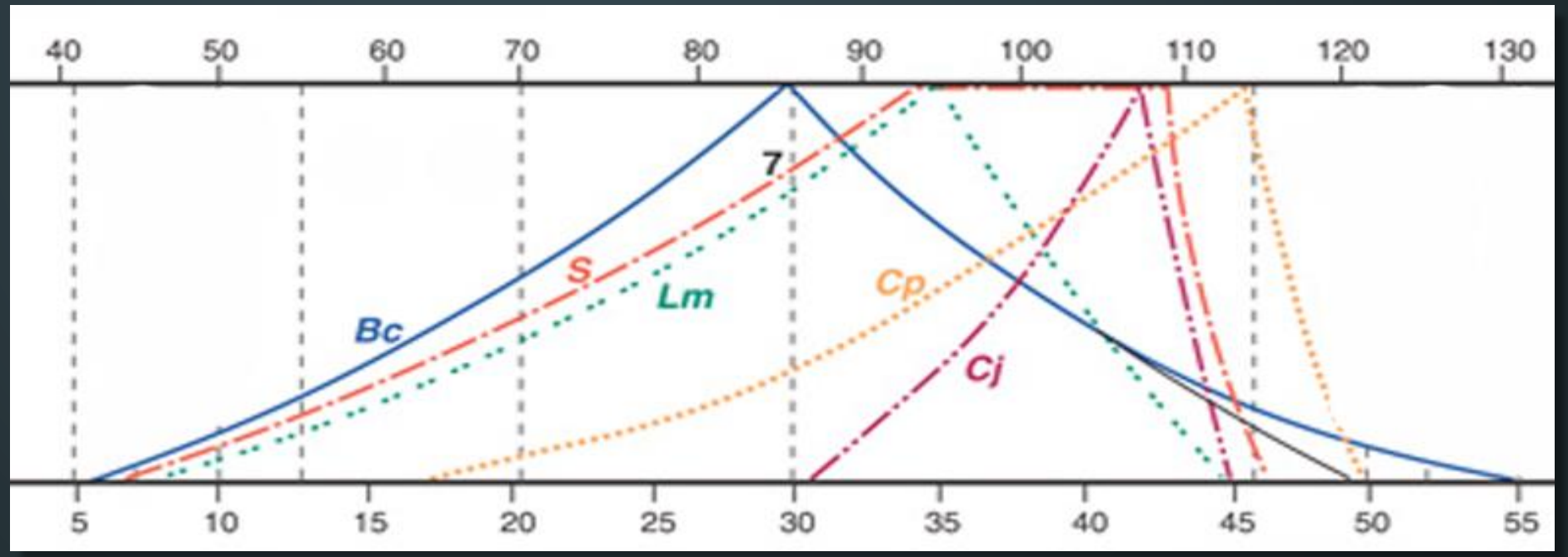
Pathogen growth temperature (°F) minimums – maximums

Bacillus cereus	*Campylobacter jejuni*	*Clostridium botulinum*	psychrotrophic *Clostridium botulinum*	*Clostridium perfringens*	***Escherichia coli* O157 H7**
40 - 131 50 - 110 toxins	86 - 113	50 - 118	38 - 113	50 - 126	**44 - 122**
Listeria monocytogenes	*Salmonella*	*Shigella*	*Staphylococcus aureus*	Vibrios	***Yersinia enterocolitica***
34 - 113	41 - 115	44 - 117	50 - 118	41 - 113	**34 - 108**



SV

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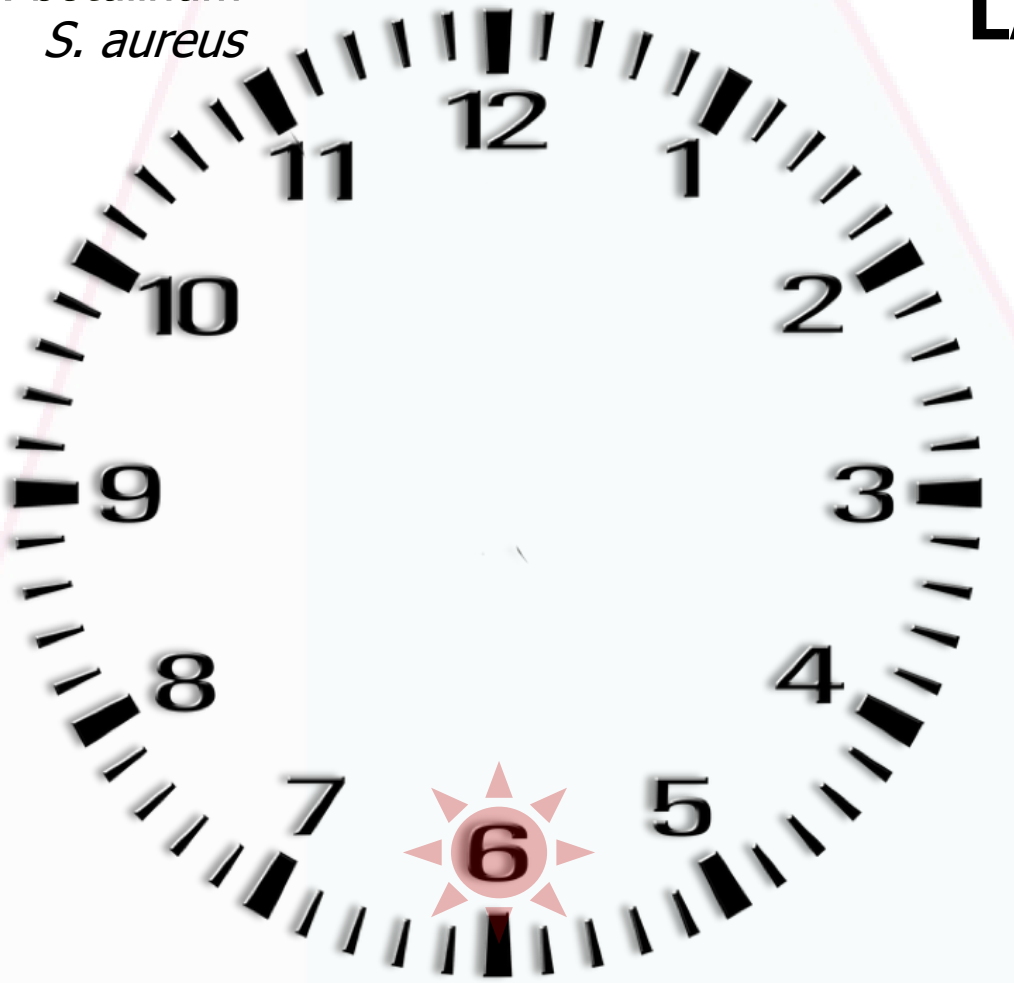
COME UP TIME

?growth 50-126ºF
?toxins 50-126ºF

C. botulinum
S. aureus



B. cereus
C. perfringens

LAG TIME

SV

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- Cook
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- Cold Hold

Temp °F	Temp °C	Time for 5.0 log *Ec* Reduction Min.
130	54.4	86
131	55.0	69
132	55.6	55
133	56.1	44
134	56.7	35
135	57.2	28
136	57.8	22
137	58.4	18
138	58.9	14
139	59.5	11
140	60.0	9
141	60.6	7
142	61.1	6
143	61.7	5
144	62.2	4
145	62.8	3
146	63.3	130
147	63.9	103
148	64.4	82
149	65.0	65
150	65.6	52
151	66.1	41
152	66.7	33
153	67.2	26
154	67.8	21
155	68.3	17
156	68.9	14
157	69.4	11
158	70.0	0
159	70.6	0
160	71.1	0

7D log reduction *Salmonella*

Temperature (^{o} F)		Time for Chicken	Time for Turkey
rubbery texture	136	81.4 min	70.8 min
	137	65.5 min	58.5 min
	138	52.9 min	48.5 min
	139	43 min	40.4 min
	140	35 min	33.7 min
	141	28.7 min	28.2 min
	142	23.5 min	23.7 min
	143	19.3 min	19.8 min
	144	15.9 min	16.6 min
	145	13 min	13.8 min
	146	10.6 min	11.5 min
	147	8.6 min	9.4 min
	148	6.8 min	7.7 min
	149	5.4 min	6.2 min
	150	4.2 min	4.9 min
	151	3.1 min	3.8 min
	152	2.3 min	2.8 min
	153	1.6 min	2.1 min
	154	1.1 min	1.6 min
	155	54.4 sec	1.3 min
	156	43 sec	1 min
	157	34 sec	50.4 sec
	158	26.9 sec	40.9 sec
	159	21.3 sec	33.2 sec
	160	16.9 sec	26.9 sec
	161	13.3 sec	21.9 sec
	162	10.5 sec	17.7 sec
	163	<10.0 sec	14.4 sec
	164	<10.0 sec	11.7 sec
	165	<10.0 sec	<10.0 sec

USDA United States Department of Agriculture
Food Safety and Inspection Service

SV

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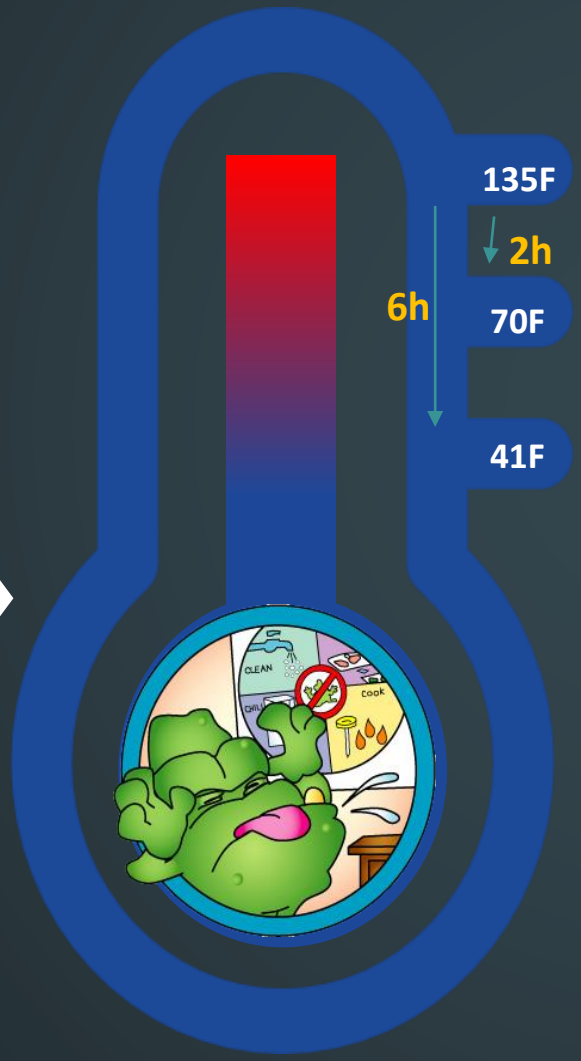

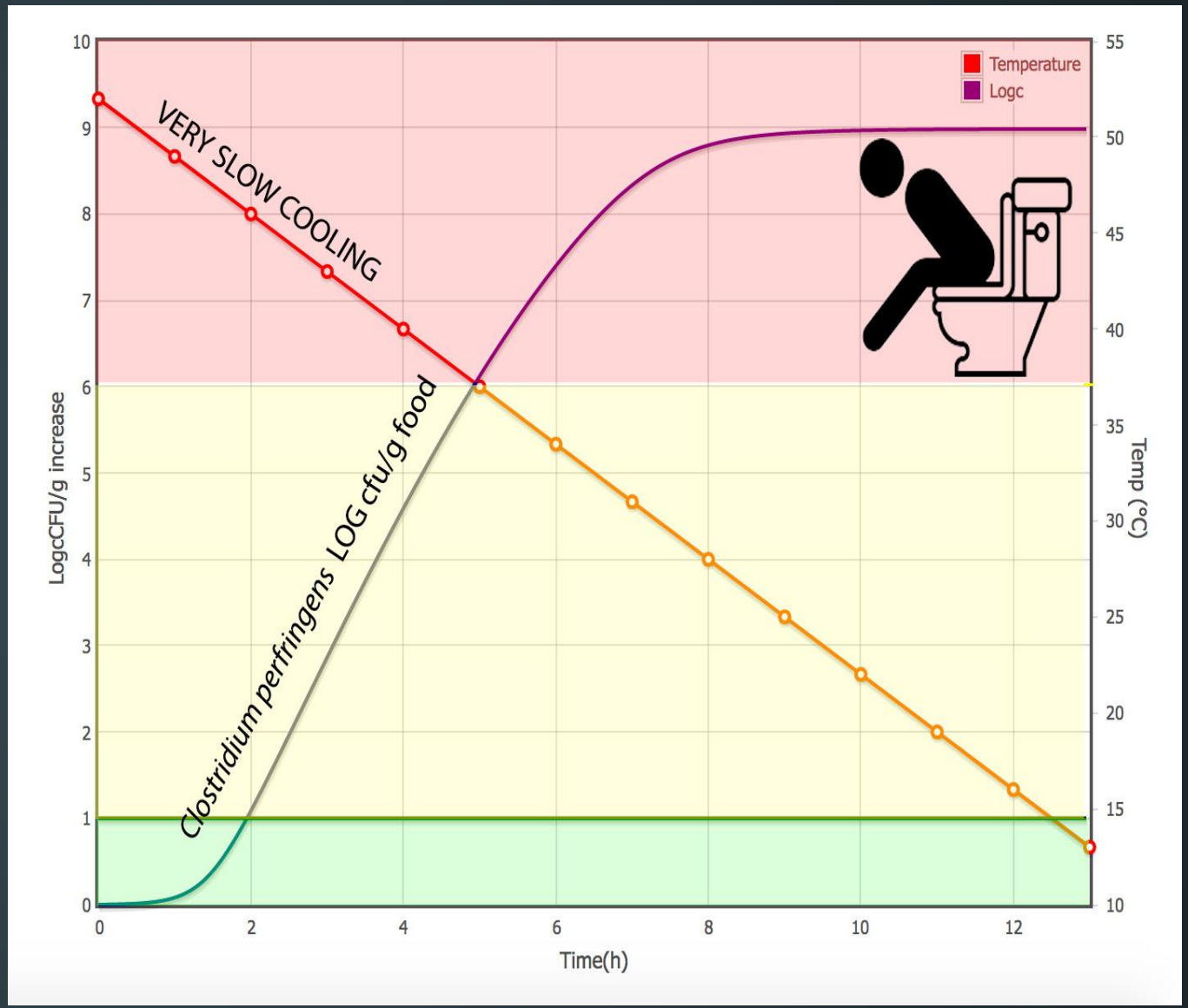

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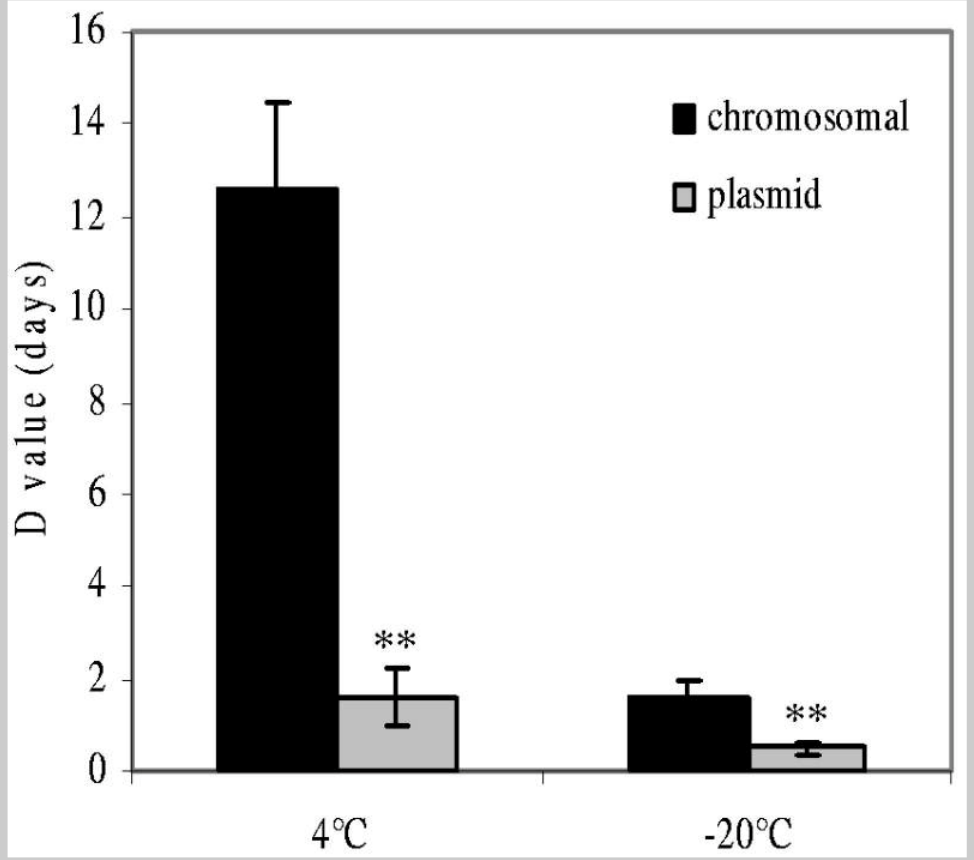
C perfringens cell *death* during cold holding

Appl Environ Microbiol. 2006 Jul; 72(7): 4561–4568.
doi: 10.1128/AEM.00177-06
PMCID: PMC1489334
PMID: 16820444

Further Comparison of Temperature Effects on Growth and Survival of *Clostridium perfringens* Type A Isolates Carrying a Chromosomal or Plasmid-Borne Enterotoxin Gene

Jihong Li and Bruce A. McClane*



What about *Listeria monocytogenes* during cold holding SV foods?

Psychrotrophic *C. botulinum* risk analysis

SV

- VP
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Salt 1-5%

9 d ≤ 41F

USA ROP
Outbreaks = 0

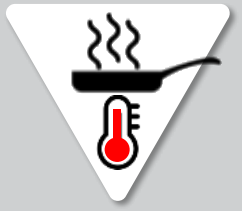
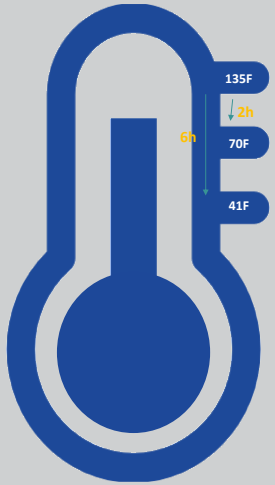
Salt ≥ 5%
Aw < 0.97
pH ≤ 5.0

≤ 38F

HACCP SUMMARY

SV

- VP
- Cook
- Chill
- Cold Hold

COOK	CHILL	COLD HOLD
Safe come up time "incubation" ⊘ 50-126F  Cook time@ temperature to USDA beef/pork or poultry cooking standards	3-501.14 Standard 	3-502.12 Standards 30 d @ ≤ 34F HACCP 7 d @ ≤ 41F HACCP 2 d @ ≤ 41F 3-502.12 (F) ⊘ HACCP

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