Controlling *Salmonella* Past the Primary Critical Control Point

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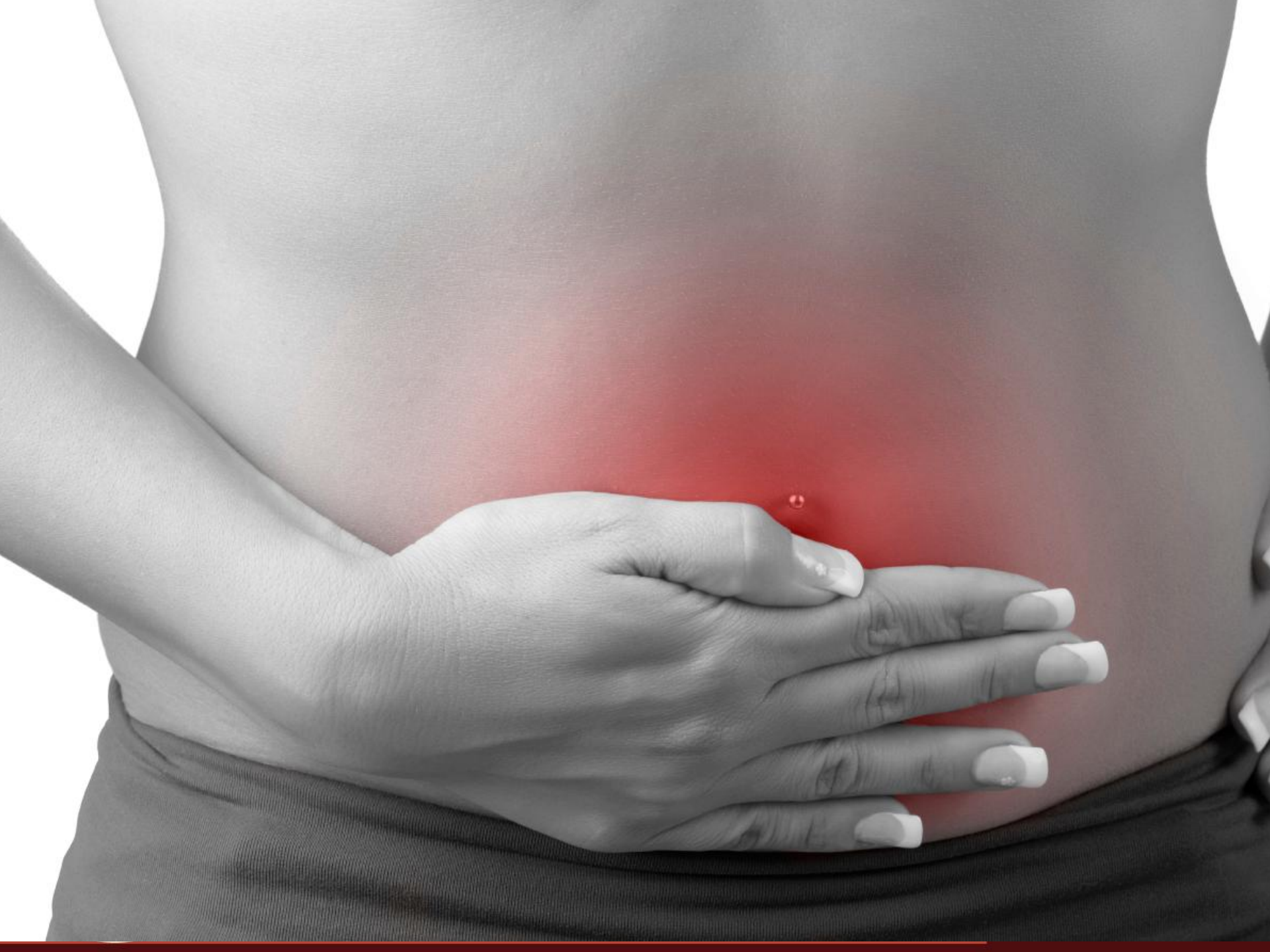
Safe Food ?

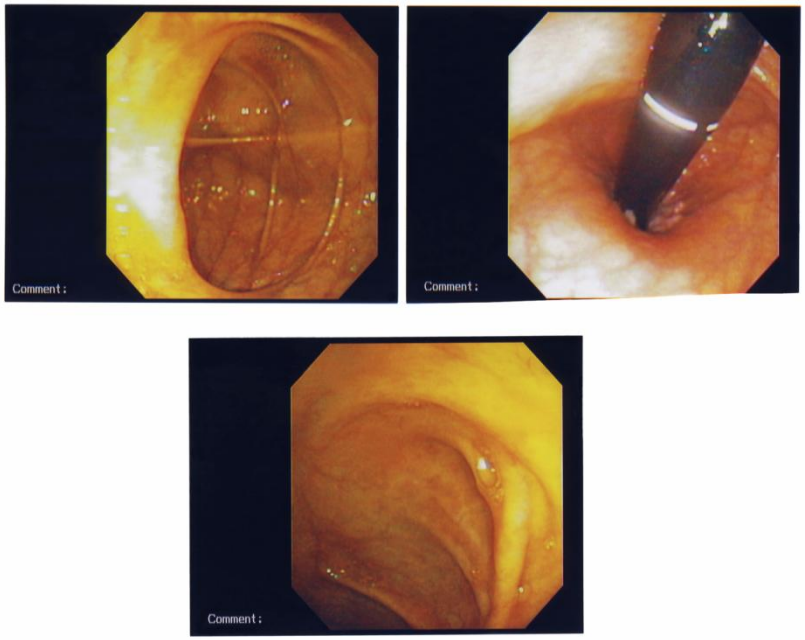
“Multistate Outbreak of Human *Salmonella Infantis* Infection Linked to Dry Dog Food”

CDC, Centers for Disease Control and Prevention, Salmonella, Salmonella Homepage. 2014. (www.cdc.gov/salmonella/outbreaks-2024.html)

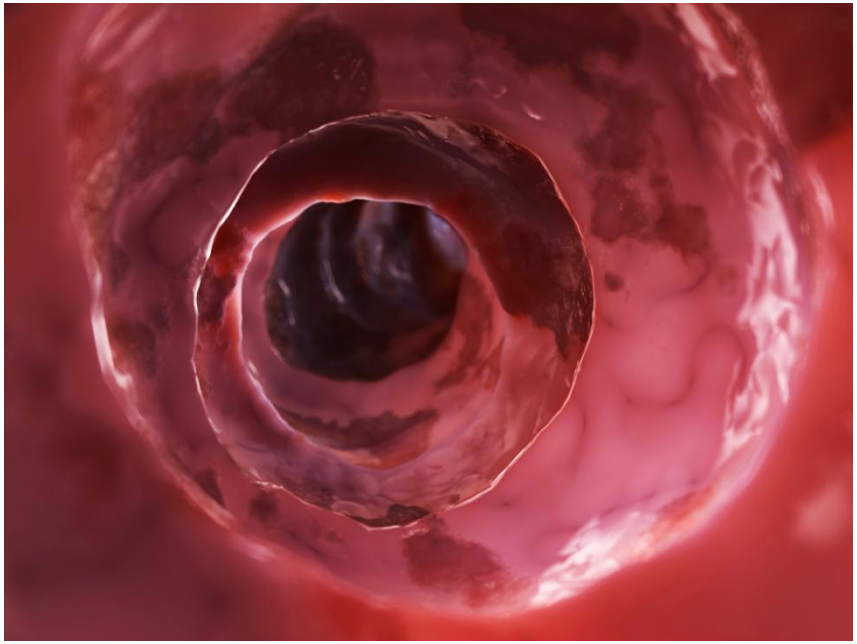


Salmonellosis

Normal Colon



Salmonellosis Colon



Pathogens or “Bad Bacteria”

Salmonella – Most prevalent offending organism

And “friends”…

- Pathogenic *Escherichia coli*
- *Listeria monocytogenes*
- *Staphylococcus aureus*
- *Clostridium botulinum*
- *Camplyobacter jejuni*

Many Salmonella Sources of Risk

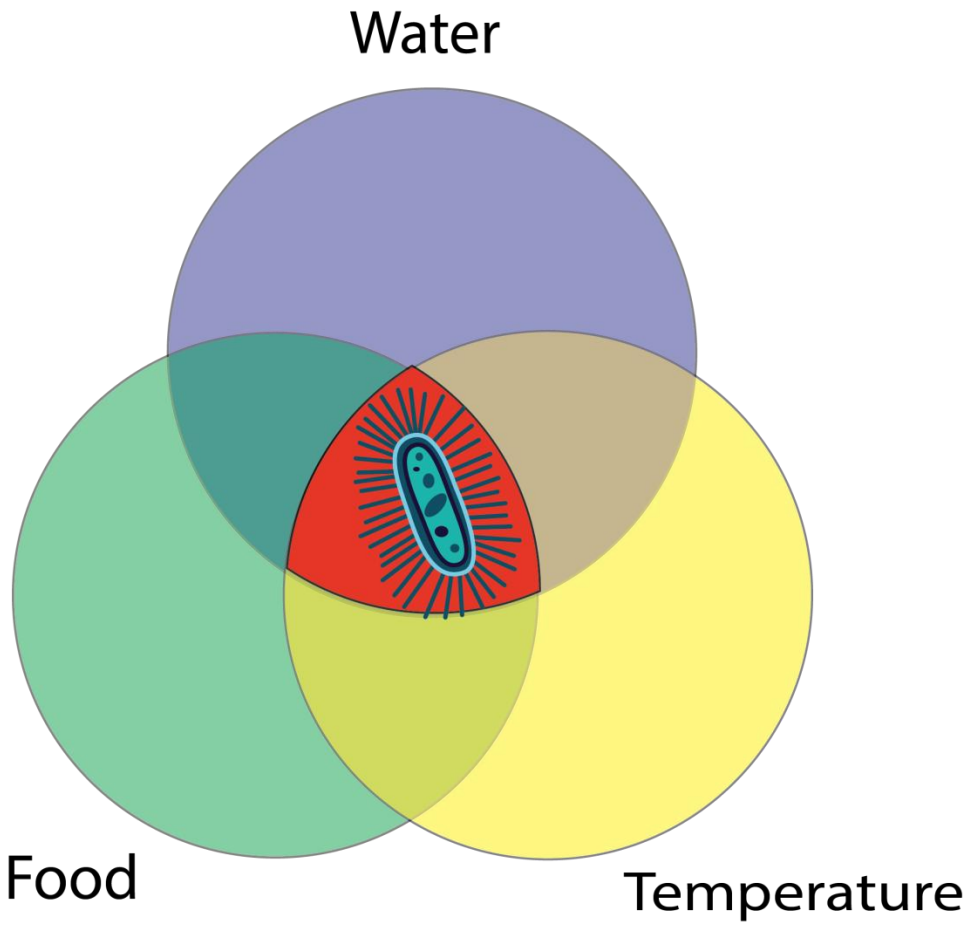
- Wet or dry, raw or processed ingredients
- Birds, rodents and insects
- Human transmission
- Salmonella niches can and do exist in plants despite GMP & HACCP protocols
- Air flow from salmonella hot areas
- Roof leaks
- Vegetable or grain products

→Many sources of contamination or re-contamination risk

How are Salmonella controlled in a Dry Pet Food Plant?

- The Extrusion of meat mixes kills Salmonella
  - Validated
- Water control is critical to preventing growth niches in the production area
  - Environmental Testing

Salmonella Only Needs 3 Things



How Are We Doing?

Current Solutions Have Limitations

Approach	Effectiveness
Better GMP/HACCP adherence	Good but not enough
More training	Good but not enough
Better factory design	Good but not enough
More testing	Good but not enough
Dryer burn outs	Root cause unaddressed
“Hot spot” eradication	Root cause unaddressed
Irradiation	Public concern
Acidified Coating	Somewhat but not enough

Regulatory Pressure High

- 2011 FDA Guidance for Industry: Testing for Salmonella species in Human Foods and Direct Human-Contact-Animal Foods
- 2011 Food Safety Modernization Act aims to ensure the U.S. food supply is safe by shifting the focus from responding to contamination to preventing it
- More Testing and Pulsed Field Gel Electrophoresis
- FDA demands scientific, fact-driven approaches to pathogen control – validation is essential

Pathogen Limits: FDA Guidelines

- Salmonella
  - negative in 750g
  - Raw Chicken has 1 to 1000 cfu Salmonella/g and is a hazard to dogs and pet owners.
- Pathogenic *E. coli*
  - negative in 100 g
  - Hemorrhagic *E.coli* is associated with dairy beef and is a hazard to dogs and pet owners.
- FD&C Act: "Any food with a toxic and deleterious substance is in violation of the Act."

New Solutions Needed

“If you don’t like bacteria,

you are on the wrong planet!”

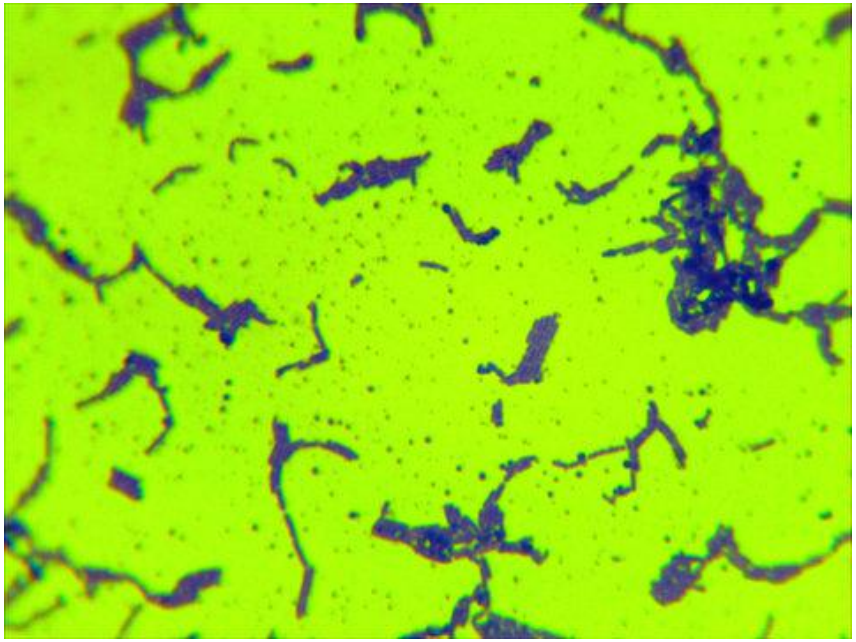
Re-think Bacteria

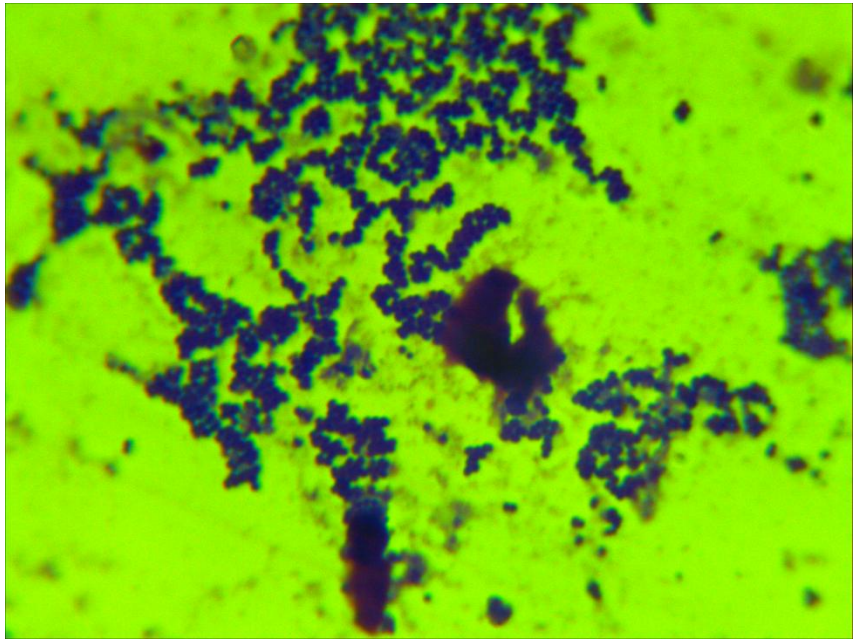
- Conventional wisdom states that any bacterium is bad in a manufacturing environment
- We enjoy the presence of beneficial bacteria in many products: yogurt, pickles, cheese, sourdough bread, etc.
- Bacteria are an important part of our body in order for it to function properly especially in the lower G.I. tract
- **Selective application of beneficial bacteria to a manufacturing process can help control pathogens and food spoilage**

ActivePal™

- A new beneficial bacteria based technology – unique culture containing live bacterial cells
- Culture is grown and harvested under precise conditions to optimize efficacy and safety
- Spray application compatible with existing kibble palatant coating systems to kill Salmonella and other enteric bacteria
- *Patent Pending*

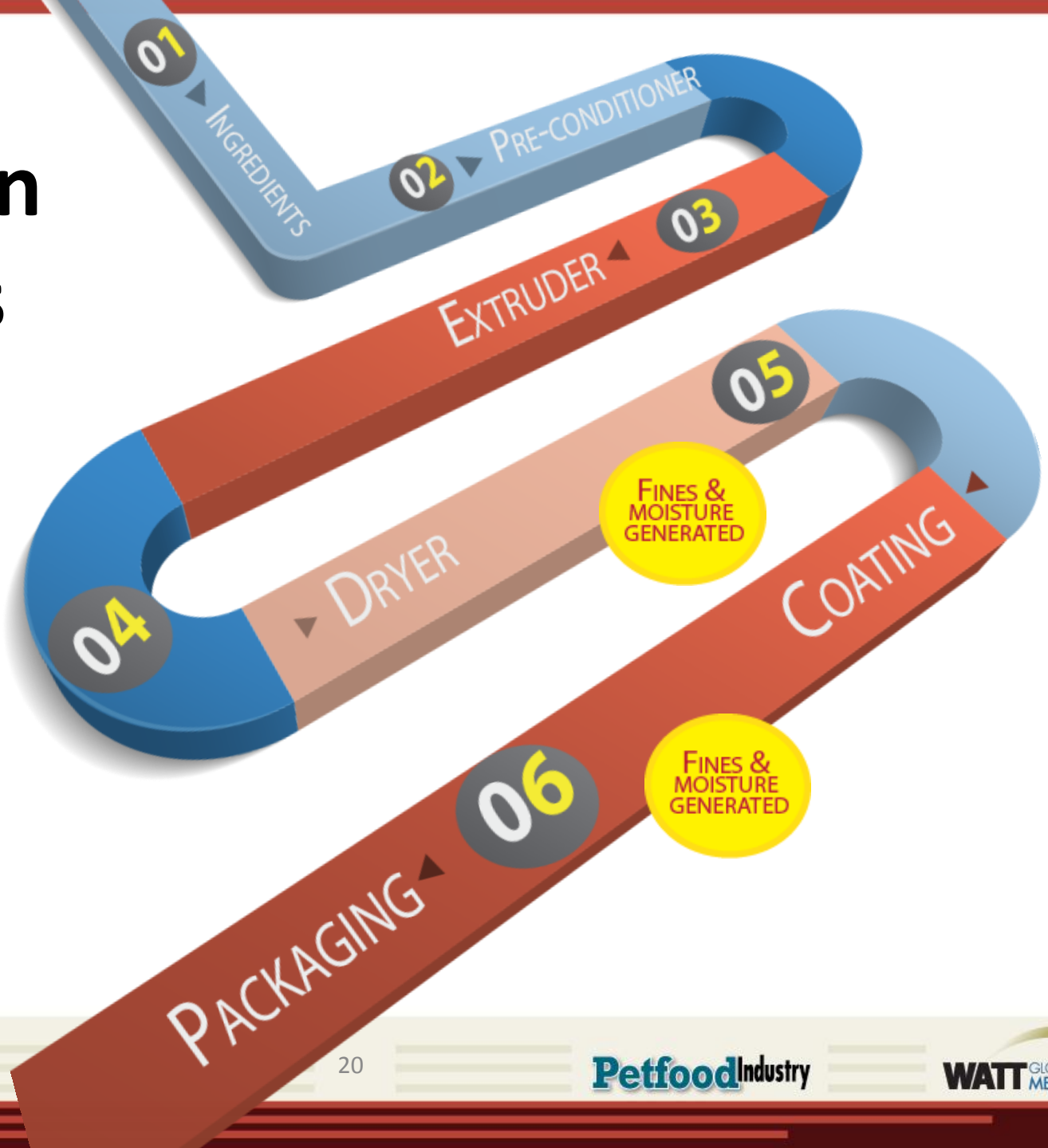
Beneficial Bacteria



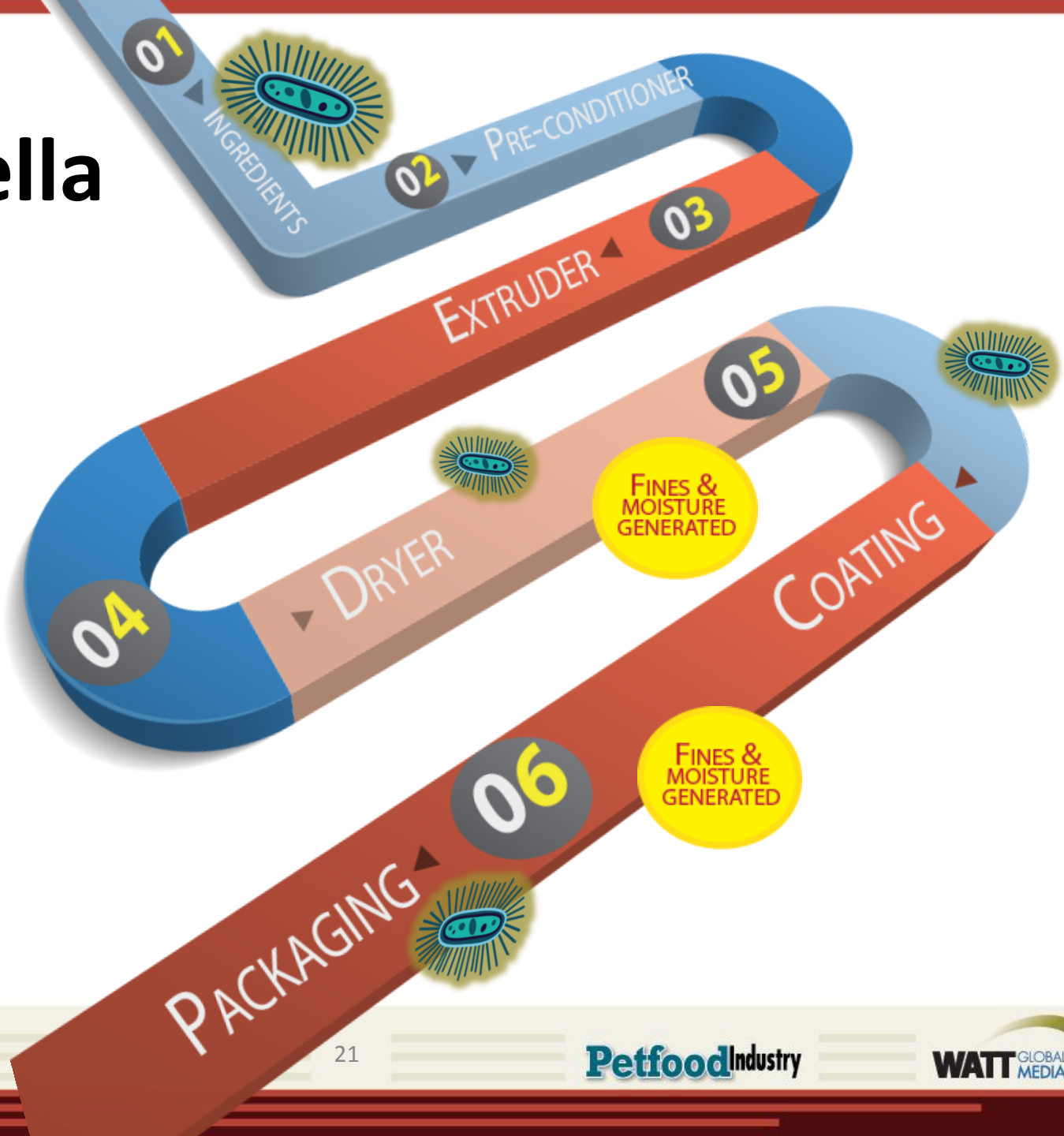


Application Example

Extrusion Process



Salmonella Risk



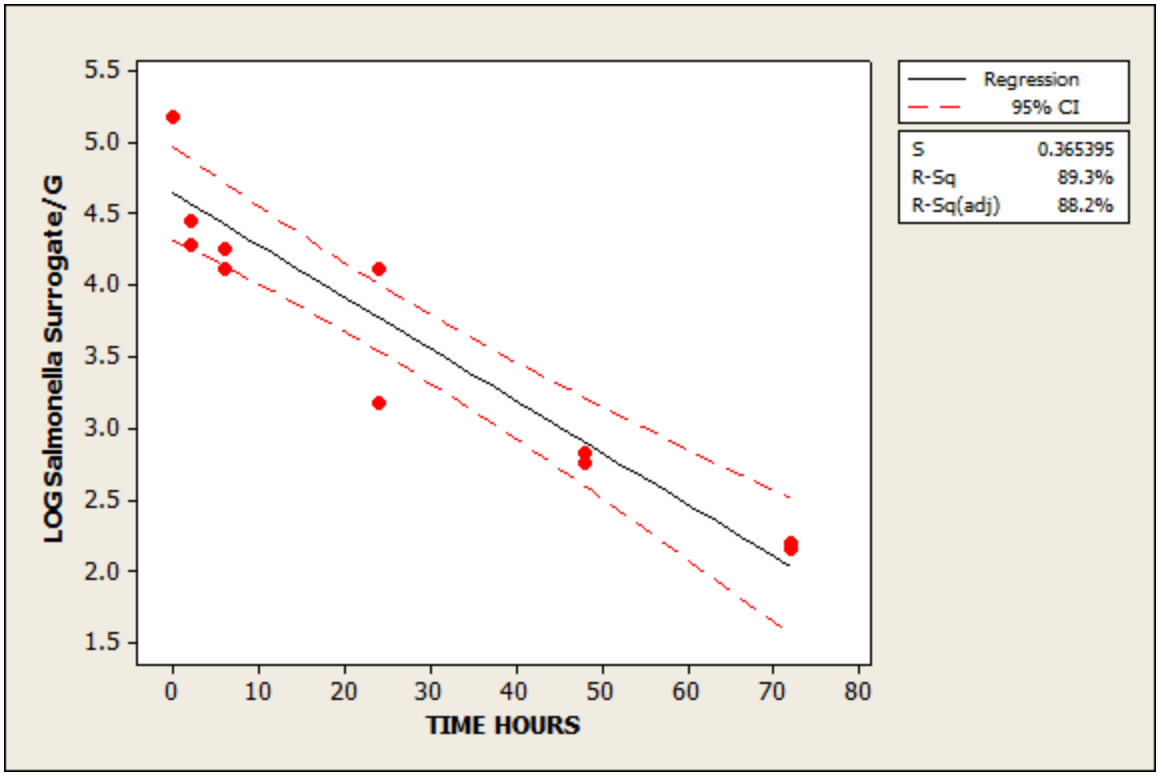
Salmonella Risk

Efficacy Data

Use of Salmonella Surrogates to Understand the Efficacy of a New Technology

- Salmonella surrogates avoid direct handling of pathogens for research purposes
- Salmonella surrogates are an approved technique for research purposes
- Examples of Salmonella surrogates: Escherichia coli Biotype 1

Fate of Salmonella Surrogates on Kibbles Prior to Fat/Palatant Coating

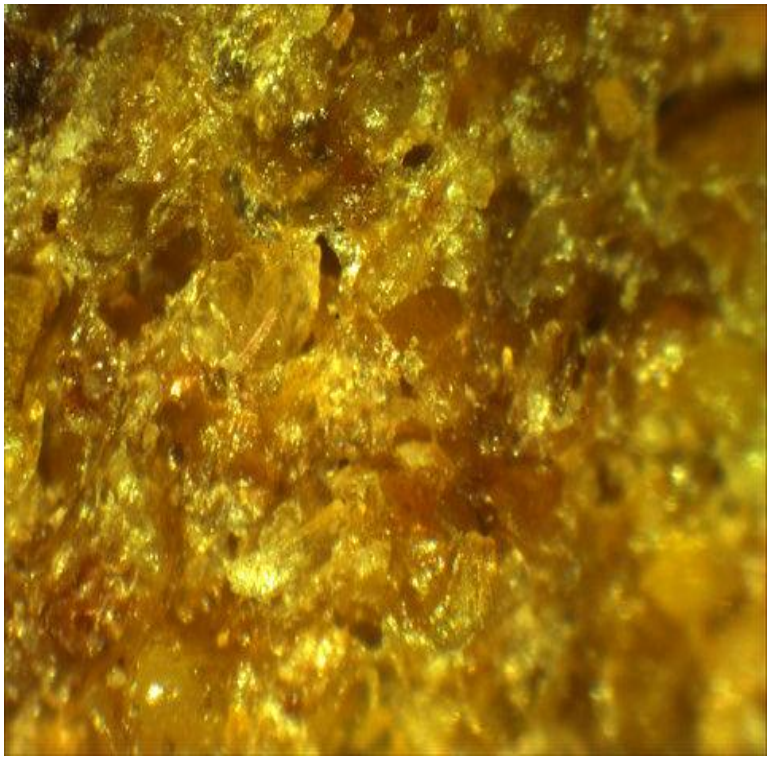


Note: Salmonella surrogates added first followed by Active Pal

Double Protection for Kibbles

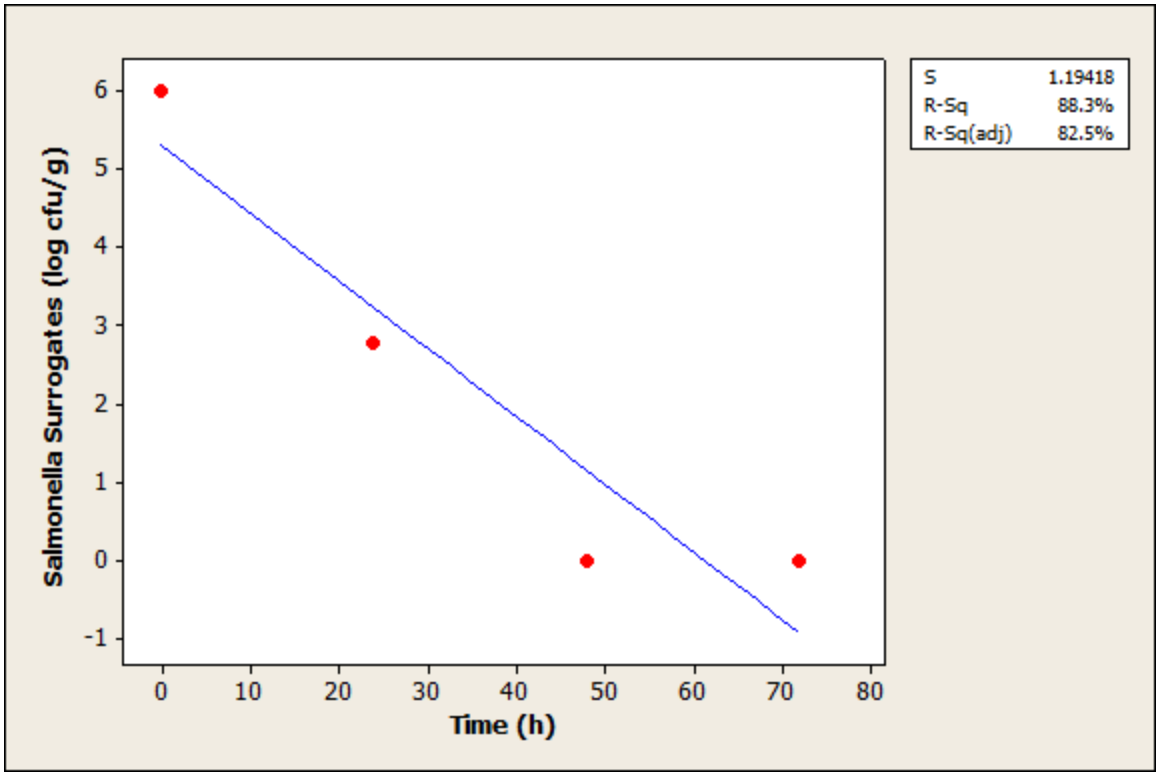
Decontamination – Kills Salmonella on contaminated kibbles

Protects – Prophylactic Salmonella control to protect from inadvertent exposure after coating



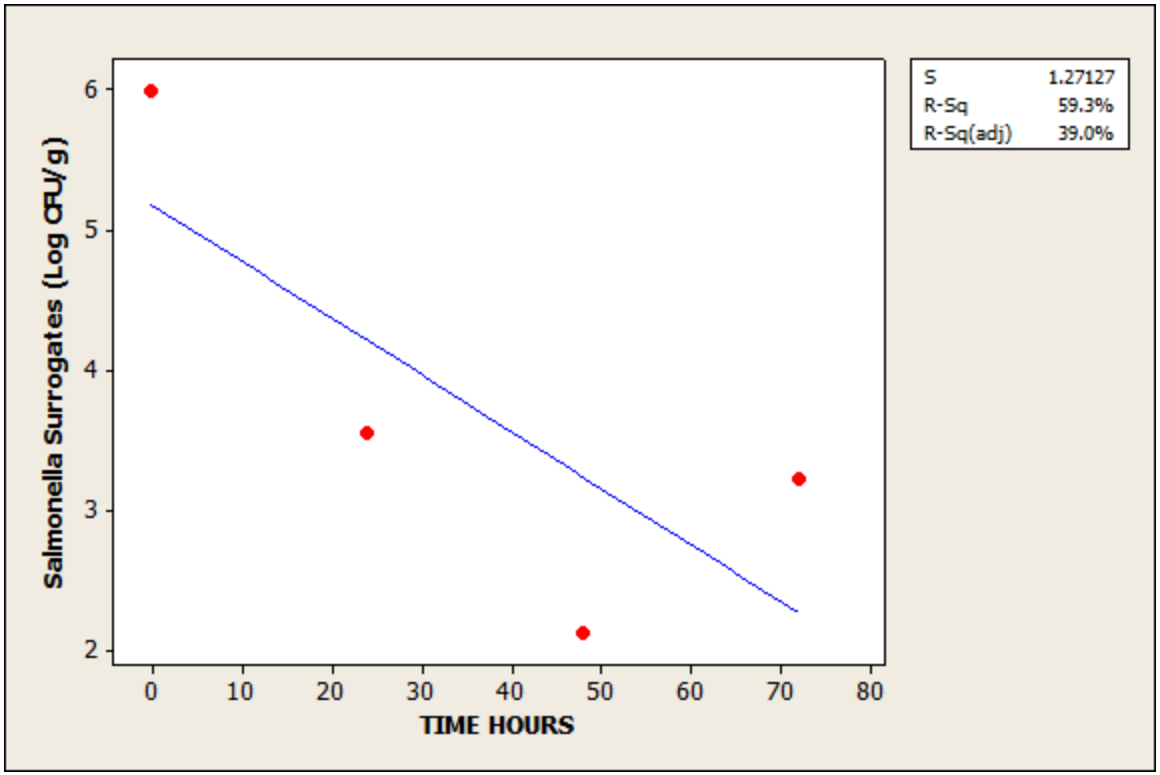
Kibble Exterior

Salmonella Control of Contaminated Kibbles During 72 h of Gradient* Incubation



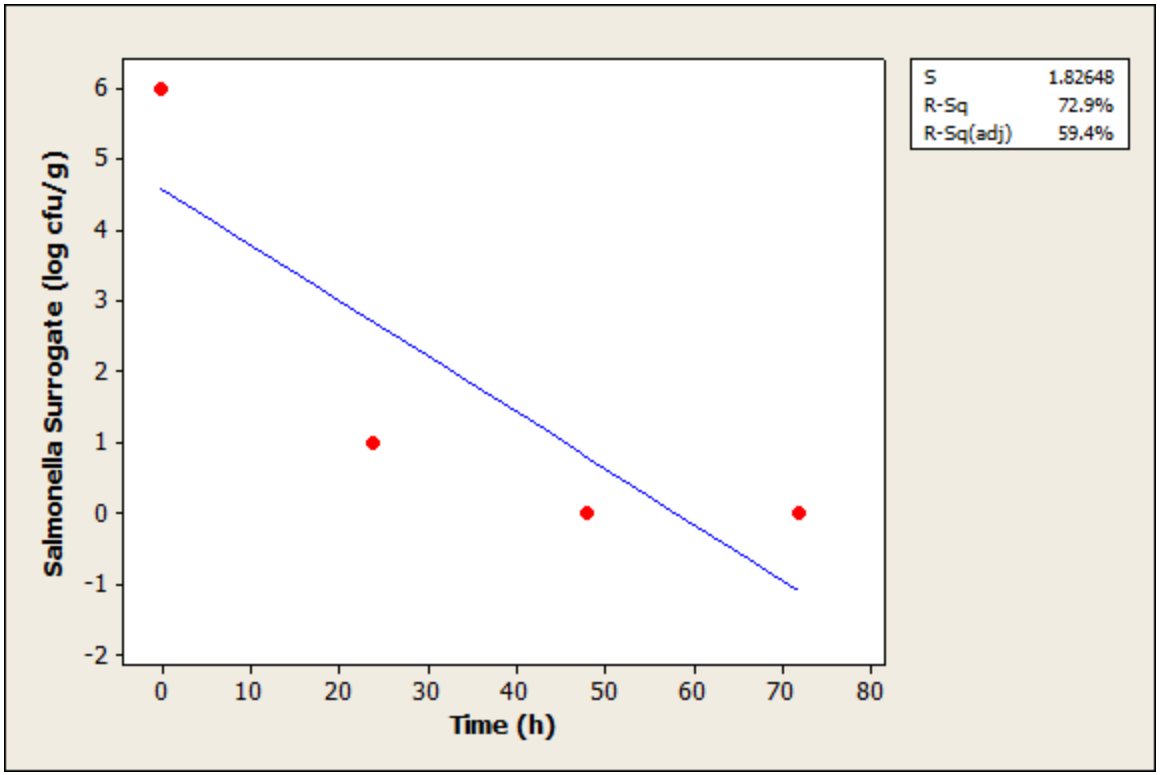
Note: Salmonella surrogates added first followed by Active Pal
*37° C for 4h, then 24° C for 68h

Salmonella Control of Contaminated Kibbles During 72 h of Incubation at 24° C



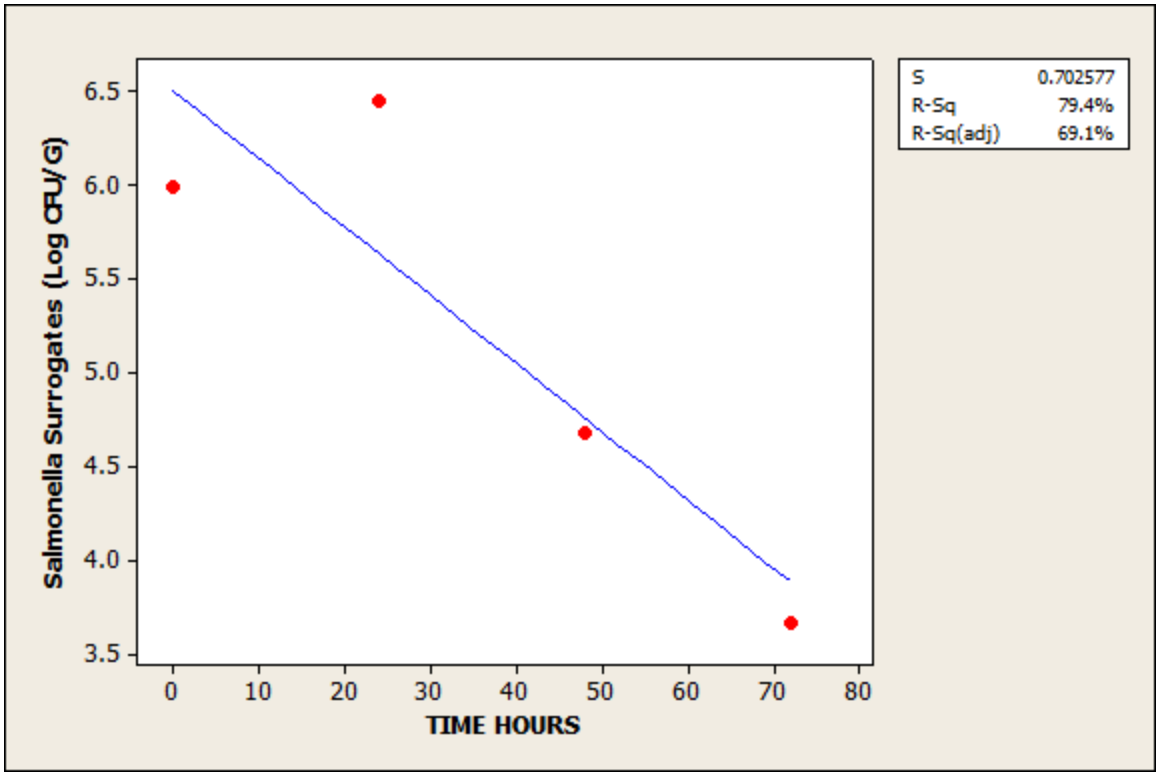
Note: Salmonella surrogates added first followed by Active Pal

Salmonella Control on Contaminated Kibbles During 72 h of Incubation at 37° C



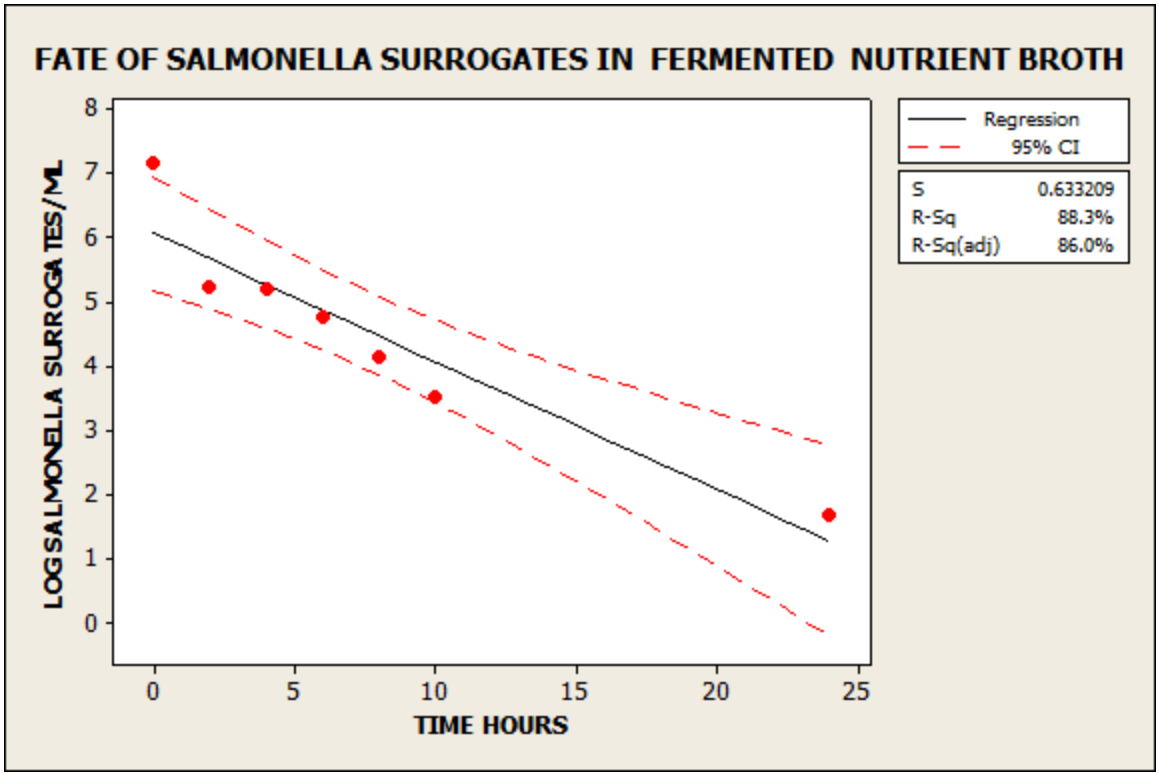
Note: Salmonella surrogates added first followed by Active Pal

Fate of Salmonella During 72 h of Incubation at 24° C

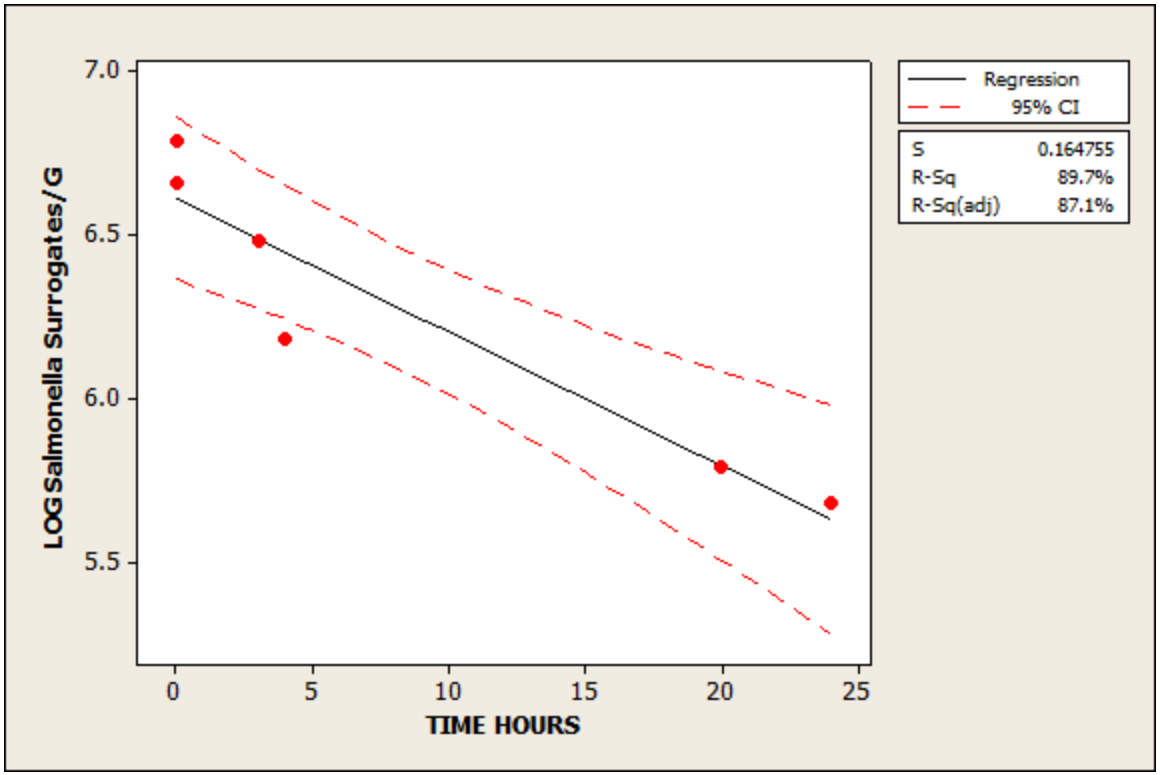


Note: Active Pal added first followed by Salmonella surrogates

Fate of Salmonella in Fermented Nutrient Broth After 24 h of Incubation



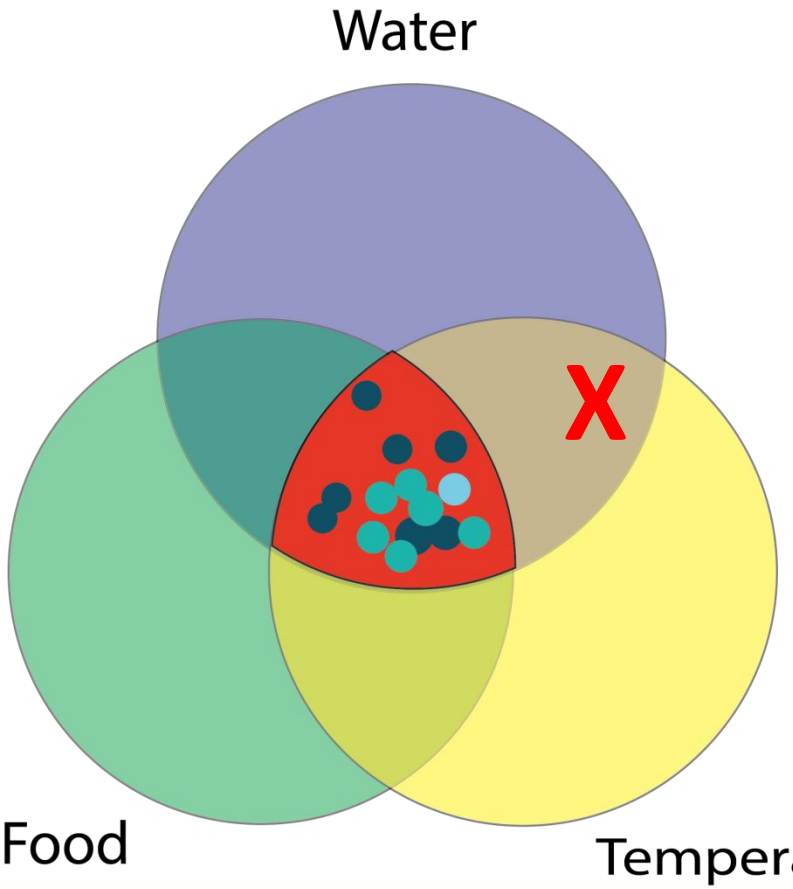
Fate of Salmonella Surrogates on Dried Fruits and Vegetables During 24 h of Incubation



Note: Salmonella surrogates added first followed by Active Pal

Natural Process

Beneficial bacteria need 3 things to grow:



THANK YOU

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