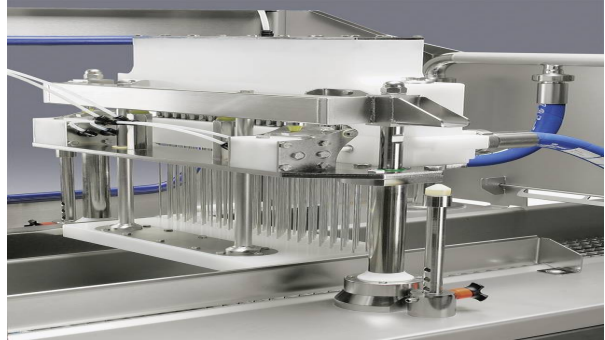




## **Increasing Shelf Life of Injected Meats**



For centuries, the benefits of enhancing meat flavor and texture with injected brines, marinades and phosphates has been well accepted as a way to add value to customers, while also improving marketability by improving color, texture and shelf life. The modern injection process typically consists of five main components – injector needles, brine or marinade mixing tanks, filters, heat exchanger and saddle tank, all connected in a recirculation loop with sanitary CIP piping.

The injection process is inherently susceptible to microbiological challenges in the brine/marinade and equipment components. Therefore, a thorough microbiological testing and sanitation protocol is important to achieve and maintain product quality and integrity.

### **Brine Dumping**

Throughout the course of a processing day, the microbial levels of the injected solution increase as it is recirculated, until it reaches a predetermined level. At this point, the solution must be discarded or “dumped”, and a new batch of solution mixed before continuing production. While this procedure ensures that the injected solution is maintained at safe levels, it does not address the sanitation component of the injection process.

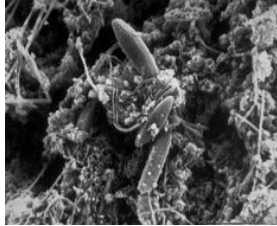
### **Sanitation of the Injection Loop Components**

By its nature, the injection process allows the needles to transfer surface skin pathogens and spoilage bacteria into the muscle tissue. While proper cooking temperatures mitigate the food safety risks associated with this contamination, shelf life of fresh injected product can suffer dramatically as a result. Therefore, it is critical to adopt a thorough cleaning regimen for the injector and its components.

To clean the injectors, a common approach is to use a chlorinated alkaline cleaner recirculated through the system, followed by a water rinse. A vinegar solution is often used to soak the needles overnight. This helps unclog needles by loosening bone, cartilage and fat that has accumulated during the course of the day. The needles are then rinsed and blown out with compressed air.

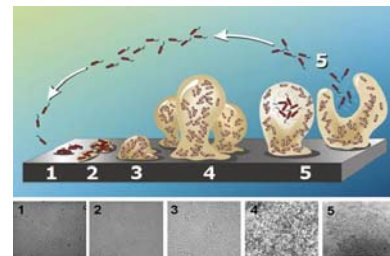
However, the approach outlined above is often not sufficient to eliminate all spoilage organisms from the injection system.

### **The Problem – Biofilm**



Biofilms are a complex matrix of bacteria, fungi and algae bound together in a sticky gel of polysaccharide and other organic contaminants attached to a surface. Organisms produce a protective, slime-like layer, in which they live, that anchors them firmly to a surface and provides a protective environment to grow and reproduce<sup>i</sup>. Biofilms generally form on any surface that is exposed to water or other liquids. Brine/marinade injection systems are particularly at risk to biofilm buildup due their nutrient enriched make-up. Pathogens in biofilm can be up to 1,000 times more resistant to traditional cleaners, sanitizers and disinfectants as compared to their free floating (planktonic) counterparts living in water based environments<sup>ii</sup>.

Given these characteristics, biofilm becomes a natural foe in the injection process. Needles, tubing, CIP piping, heat exchangers and saddle tanks are at risk, and it is not economical to disassemble and hand scrub to remove biofilm. As such, an effective biocidal, biofilm removal technology becomes crucial.



**Biofilm Life Cycle<sup>iii</sup>**

### **PerQuat® Technology**

Sterilex® PerQuat® technology contains synergistic components that lyse open the biofilm structure, kill pathogenic organisms, collapse the biofilm polymer matrix and physically lift the biofilm structure from surfaces.

In 2009, under a USDA National Research Initiative Grant, Judy Arnold of the USDA-ARS Poultry Microbiological Safety Research Unit in Athens, GA conducted a study with multiple compounds to compare their efficacy against resistant biofilm containing *Listeria monocytogenes*, a foodborne pathogen found in some ready-to-eat-meats. She published a paper entitled “Biofilms Have a New Foil” in which she reported:

“Results showed that the formulation (Sterilex) was 100 percent effective, providing total kill and more than 90 percent biofilm removal. This disinfectant is more effective than currently used disinfectants in reducing *L. Monocytogenes* biofilm growth, thus minimizing the risk of pathogenic contamination...”<sup>iv</sup>

### **Injector Case Study**

To validate the benefits of using PerQuat sanitation chemistries in injection systems, a major U.S. poultry processor conducted a shelf life study in 2012 using Sterilex Ultra Disinfectant Cleaner & Sterilex Ultra Activator Solution (a liquid PerQuat solution) to treat an injector and components for approximately two weeks, nightly. Baseline samples were collected and compared against samples of raw dark poultry meat after injector treatment with the Sterilex product. Shelf life of meat was

determined by looking at both microbiological metrics (APC, Total Coliform counts) as well as organoleptic observations. The results are shown below.

**CONTROL: DARK MEAT SHELF LIFE BASELINE - Started 7-25-12**

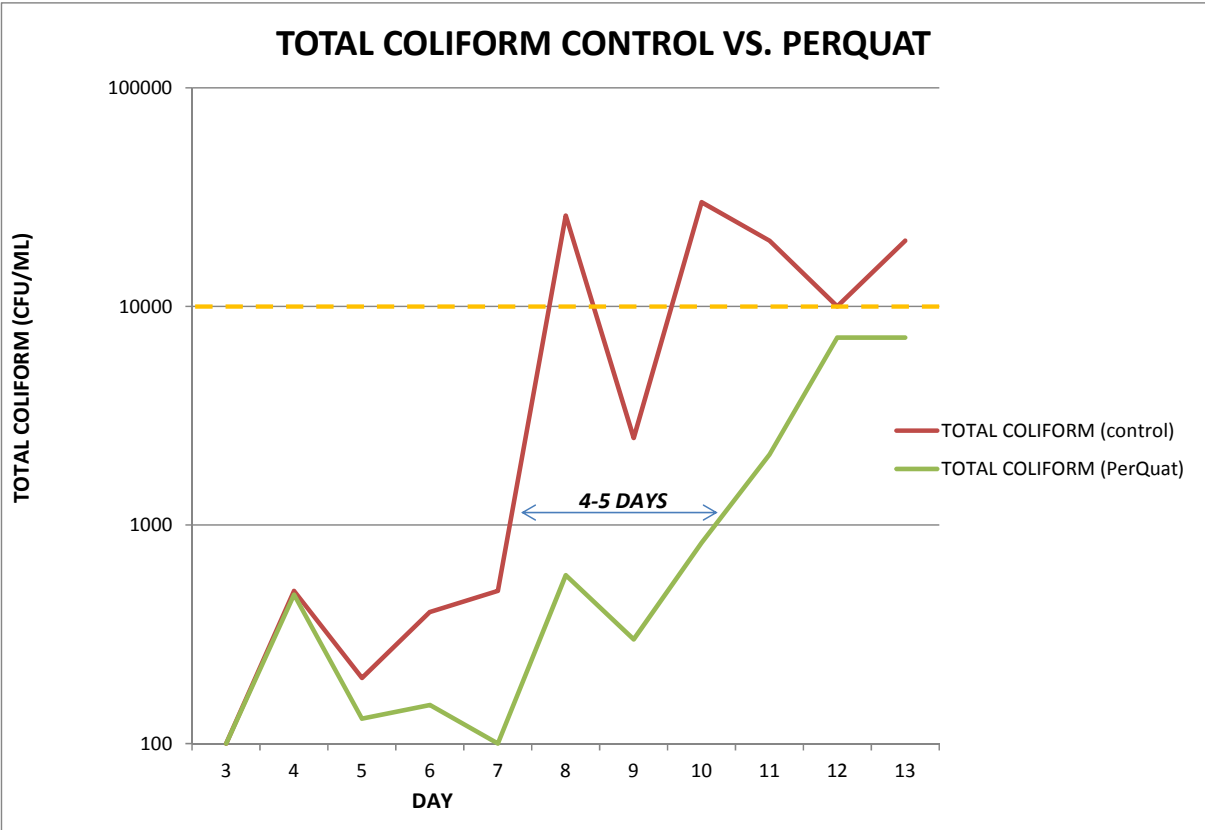
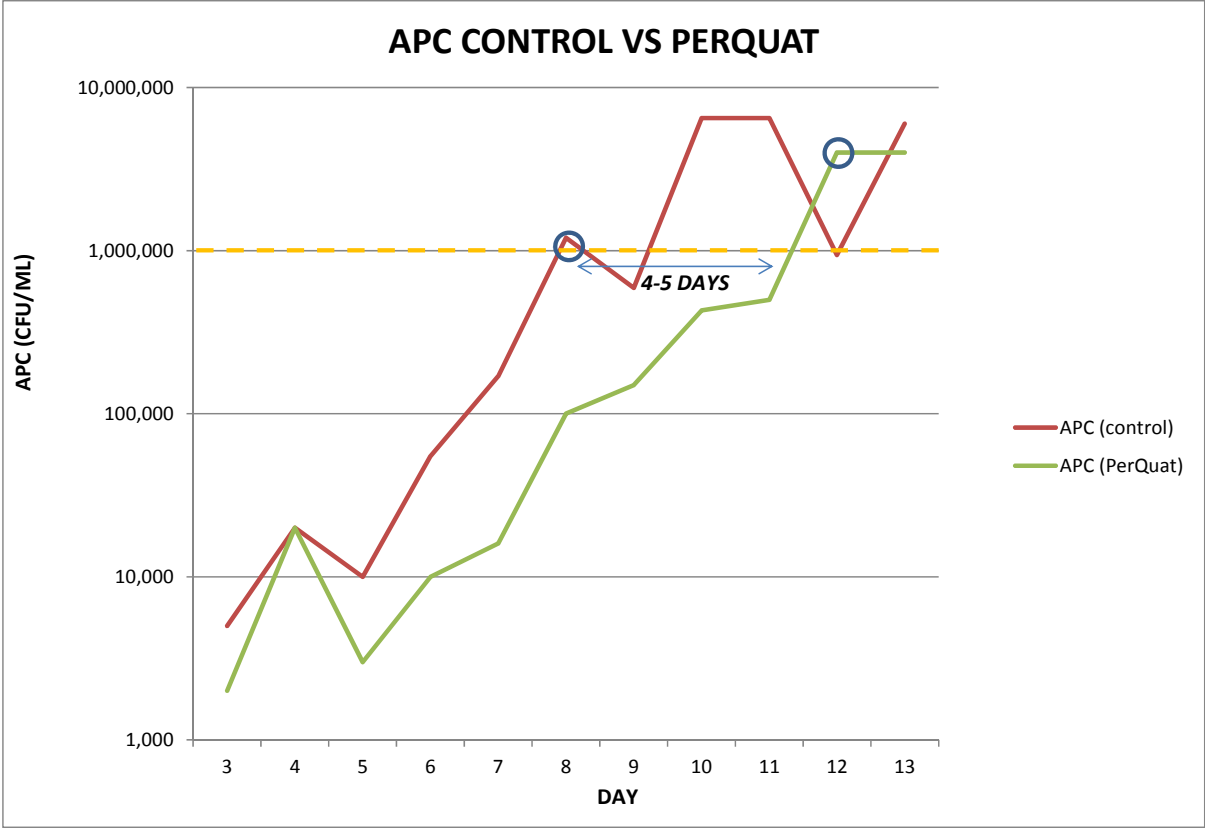
Day	APC CFU / ml	T. Coliform CFU/ ml	Odor	Color	Feel
3	5,000	100	Fresh Smell	Normal	Normal
4	20,000	500	Fresh Smell	Normal	Normal
5	10,000	200	Fresh Smell	Normal	Normal
6	55,000	400	Fresh Smell	Normal	Normal
7	170,000	500	Slight Odor	Normal	Slight Slippery Coating
8	1,200,000	26,000	Definitely Smelling	Slightly Darker	Slippery Feel
9	590,000	2,500	Slight Rancid Odor	Slightly Darker	Slippery Feel
10	6,500,000	30,000	Foul Smell/Sulfur	Brown Color	Slippery Coating on all Parts
11	6,500,000	20,000	Foul Smell/Sulfur	Grey Spots	Slippery Coating on all Parts
12	940,000	10,000	Foul Smell/Sulfur	Brown Color	Slippery Coating on all Parts
13	6,000,000	20,000	Foul Smell/Sulfur	Grey Spots	Slippery Coating on all Parts
14	<b>Stopped</b>				

Control Result: Shelf life of raw dark poultry meat *before* PerQuat trial: **8 DAYS**

**TRIAL: DARK MEAT SHELF LIFE POST APPLICATION - Started 8-31-12**

Day	APC CFU/ml	T. Coliform CFU/ml	Odor	Color	Feel
3	2,000	100	Fresh Smell	Normal	Normal
4	20,000	480	Fresh Smell	Normal	Normal
5	3,000	130	Fresh Smell	Normal	Normal
6	10,000	150	Fresh Smell	Normal	Normal
7	16,000	100	Fresh Smell	Normal	Normal
8	100,000	590	Fresh Smell	Normal	Normal
9	150,000	300	Fresh Smell	Normal	Normal
10	430,000	830	Fresh Smell	Normal	Normal
11	500,000	2,100	Fresh Smell	Normal	Normal
12	4,000,000	7,200	Off Odor	Normal	Tacky
13	<b>Stopped</b>		Foul Smell/Sulfur	Normal	Slippery Coating on all Parts

Trial Result: Shelf life of raw dark poultry meat *following* PerQuat application: **12/13 DAYS**



## **Discussion**

### *Micro Results*

From Day three through twelve, dramatic reductions in APC counts and total coliform counts by day were observed. In general, microbiological thresholds were reached 4-5 days later after PerQuat treatment as compared to the control sample, leading to an increase in shelf life.

### *Organoleptic Results*

Organoleptic differences between the two sets of samples were even more dramatic. The pretreatment samples began to emit odors at day seven, while the post treatment samples remained fresh smelling until day twelve.

The color of the control samples remained normal until day eight, at which time the meat began turning brown in color. Grey spotting was also observed until day thirteen when the testing was stopped. There was no discoloration of the treated samples. Color remained normal from day three through day 13.

The surface characteristics of the control samples only remained normal until day seven, at which time a slippery coating was observed on all parts. The feel of the treated samples remained normal until day twelve.

## **Conclusions**

As observed in this trial, treatment of the injector loop with PerQuat technology on a daily basis for two weeks resulted in a 4/5 day extension of shelf life for raw dark poultry meat. Delays in microbiological thresholds as well as significant improvements in organoleptic properties were seen throughout the trial.

Similar results may be observed in any plant with a brine injection process by following a similar injector treatment protocol. You may contact Sterilex Corporation directly for more information at:

800-511-1659

[Sales@Sterilex.com](mailto:Sales@Sterilex.com)

# Increasing Shelf Life of Injected Meats:

## Case Study #1 Background Information

**Type of Needles Used:** MEPSCO Ultracat 488

**Type of Product Tested:** Dark poultry meat (legs and thighs) in packaged bags

### **Control Treatment of Needles/Lines:**

1. Needles removed from the injection lines.
2. Needles soaked in vinegar solution overnight for six hours (Heinz white vinegar undiluted @ 5% acidity), then rinsed and blown out with compressed air in the morning.
3. Chlorinated alkaline foam cleaner (1.8% active chlorine, 6.9% caustic) recirculated through entire CIP injection loop for one hour followed by a thorough water rinse.

***Control Sample Shelf Life Observed: 8 days***

### **Sterilex PerQuat Treatment of Needles/Lines:**

1. Needles remain in place connected to lines.
2. Chlorinated caustic foam cleaner (1.8% active chlorine, 6.9% caustic) recirculated through entire CIP injection loop for one hour followed by a thorough water rinse.
3. Sterilex Ultra Disinfectant Cleaner & Activator Solution NF added to brine tank at a 1:1:10 concentration and circulated through CIP injection loop, filters, heat exchanger, sanitary piping and needles for one hour. The brine mixing tank was filled to the 100 gallon mark and 10 gallons of Sterilex Ultra Disinfectant Cleaner NF and 10 gallons of Sterilex Ultra Activator Solution were added.
4. Lines and needles rinsed thoroughly.
5. Needles soaked in vinegar solution overnight for six hours (same concentration as above), then rinsed and blown out with compressed air in the morning.

### **Frequency of Use of Sterilex PerQuat to Needles/Lines:**

1. Sterilex treatment used daily for two weeks for trial. Samples pulled following two week shock treatment.
2. Ongoing, Sterilex PerQuat treatment applied 1-3X per week following initial shock treatment application.

***Sterilex Sample Shelf Life Observed: 13 days***

### **Storage of Samples**

Product Temperature: 28°F - 30°F

Cooler Temperature: 34°F - 35°F

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<sup>i</sup> Chmielewski RAN, Frank JF, 2003. Biofilm Formation and Control in Food Processing Facilities. *Comprehensive Reviews in Food Science and Food Safety*, Vol. 2: 22-30.

<sup>ii</sup> Jefferson K.K., Goldmann D.A., Pier G.B, 2005. Use of Confocal Microscopy to Analyze the Rate of Vancomycin Penetration through *Staphylococcus aureus* Biofilms. *Antimicrobial Agents and Chemotherapy* 49(6):2467-2473.

<sup>iii</sup> Image used with permission from: Paul Stoodley, P. D. (2003). *Biofilm Formation in Three Steps*. Retrieved from Center for Biofilm Engineering:

<http://www.biofilm.montana.edu/resources/images/multicellularextracellular/biofilm-formation-3-steps.htm>

<sup>iv</sup> Durham, S. (2009, October). Biofilms Have a New Foil. *USDA: Agricultural Research Magazine*, Vol 59, No 9.