



**Continuous On-Line Processing
of Fecal Contaminated
Carcasses using an Acidified
Sodium Chlorite Antimicrobial
Intervention
Final Report to USDA-FSIS
November 17, 1999**

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Executive Summary

A series of five evaluations of the Sanova Continuous On-line Processing (COP) system were conducted in United States commercial poultry processing facilities between July 1998 and October 1999. The Sanova COP system is a pre-chill process which consists of the acidified sodium chlorite (ASC) antimicrobial intervention in combination with an effective carcass wash system. The objective of the five studies was to generate data which would allow the comparison of pre-chill performance for the Sanova COP process with that of conventional Off-line Reprocessing (OLR). A satisfactory result from the final data generated in these studies would be the achievement of a significant improvement in the microbiological quality of fecal contaminated carcasses plus the continued achievement of zero fecal tolerance standards.

Each study was separated into two phases. For both phases, fecal contaminated carcasses were identified (physically marked) by USDA-FSIS inspection personnel then permitted to remain on line for processing through Sanova COP. During Phase I, whole carcass rinse samples were collected from identified fecal contaminated carcasses at a series of four defined points on a single evisceration line in each plant. Samples were collected over a total of 12 days (10 samples per sample site per day) for a one-month period. The sample collection sites were as follows:

- Post Evisceration
- Post Wash
- Post Sanova
- Post Off-line Reprocessing

During Phase II, whole carcass rinse samples were again collected from identified fecal contaminated carcasses once a week in each plant for a period of 8 weeks. Samples were collected from all evisceration lines on an alternate basis (10 samples per sample site per day). In addition to microbial assay of carcass rinse samples, a subset of ten fecal contaminated carcasses were collected each day during Phases I & II at the Post Wash sample site for zero fecal tolerance assessment.

Reductions in the microbial populations between the Post Evisceration and Post Sanova sites represent the performance of the COP system i.e. the combination of an effective carcass wash system and an antimicrobial intervention process. Likewise, comparison of the microbial populations between the Post Evisceration and Post Off-line Reprocessing sites represent the performance of normal plant practice for handling fecal contaminated carcasses. For two of the evaluations, post-chill data were also accumulated during the Phase II sampling period.

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All carcass rinse samples were collected by trained, independent personnel, then shipped as fresh, chilled (not frozen) material to a contract laboratory for further processing. At the laboratory, all plating and microbiological assessments were completed. Butterfield's phosphate diluent containing 0.1% thiosulphate was used for all carcass rinse samples. Thiosulphate was incorporated in the carcass rinse solutions for the reduction of any residual oxidant chemistries that might still be present on the carcass surfaces (acidified sodium chlorite or chlorine).

In addition to enumeration of *Escherichia coli* and qualitative (%) assessments of *Salmonella* spp., quantitative and qualitative microbiological assessments were also made for *Campylobacter* spp.

Carcass rinse sample handling practices were also assessed during three of the in-plant tests. In these evaluations, carcass rinse samples were split at the time of collection and one half was handled as per normal procedures as a typical fresh chilled sample. The second half of the sample was placed into a container of dry ice and frozen prior to final packaging and shipment.

A comparison of the microbiological data from these two sets of data provided an evaluation of the effects of sample freezing on microbial survival and thereby the potential for generation of false negative data.

The data from each of the five studies, by phase, have been separately reported to USDA-FSIS and this report merely provides a summary of the combined results. The overall conclusions to be derived from the data generated during this test series are as follows:

1. The Sanova COP process was able to significantly improve the microbiological quality of fecal contaminated carcasses. Sanova COP achieved an average reduction in *E. coli* of 2.28 \log_{10} cfu/ml and in *Salmonella* incidence of 27.27% when compared with the post-evisceration contamination levels. In comparison, off-line reprocessing was only able to reduce *E. coli* by 0.50 \log_{10} cfu/ml while *Salmonella* incidence remained unchanged.
2. ASC treatment by itself had the most significant impact on distribution of *E. coli* counts post-treatment resulting in the highest proportion of samples assisting in the likelihood of plant compliance to USDA microbiological standards.
3. The Sanova COP process was able, under normal commercial use conditions, to sustain acceptable compliance to zero fecal tolerance standards.
4. While ensuring acceptable compliance to zero fecal tolerance standards, the carcass wash components of the Sanova COP systems in all five plants were also able to ensure the achievement of a microbiological carcass quality that was either, better than, or at least no worse than that achieved by off-line reprocessing.

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5. On its own, the ASC antimicrobial intervention process achieved an average reduction in *E. coli* of 1.68 log₁₀ cfu/ml and reduction in Salmonella spp. incidence of 21.40%. Post treatment residual counts for *E. coli* averaged 0.59 log₁₀ cfu/ml (4 cfu) while residual incidence for Salmonella averaged 10.00%
6. ASC had a very significant impact on Campylobacter spp. Average reductions of 1.48 log₁₀ cfu/ml and 25.65% were seen for quantitative and qualitative assessments respectively. Campylobacter populations were typically one log₁₀ cfu/ml greater than those seen for *E. coli* during the course of these studies. Post treatment residual populations averaged 1.14 log₁₀ cfu/ml (14 cfu) and had an incidence rate of 49.13%.
7. The improvements that were achieved by the Sanova COP system in the microbiological quality of poultry carcasses pre-chill were generally carried into and through the chill process and were therefore a significant factor in helping the plants to achieve USDA's post-chill microbiological standards for *E. coli* and Salmonella spp.
8. The practice of freezing of carcass rinse samples was clearly shown to result in the decreased survival of *E. coli* and Salmonella spp. Typically *E. coli* samples were reduced by an average one log₁₀ cfu/ml following freezing while Salmonella spp. incidence was seen to decline by almost 50%. These reductions had a direct and significant impact on the distribution of the *E. coli* counts and resulted in higher proportions of the population achieving microbiological compliance status.

In summary, the Sanova COP process utilizing the ASC antimicrobial intervention process was demonstrated to be highly effective and to be a significant improvement over current off-line reprocessing practices. The ASC antimicrobial intervention process was also demonstrated to have a very significant impact on Campylobacter spp.

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**Protocol for the Evaluation
of the Sanova Food Quality
System for use in the
Continuous Online Processing
of Fecal Contaminated
Poultry Carcasses**

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CONTINUOUS ON-LINE PROCESSING OF FECALLY CONTAMINATED POULTRY CARCASSES

1. Statement of Purpose:

This proposal is for the continuous on-line processing of poultry carcasses accidentally contaminated during the evisceration process. The proposed testing is to establish the effectiveness of the combined use of an inside/outside bird washer for removal of visible feces, followed by the application of a USDA approved antimicrobial treatment (Appendix 1) to all carcasses to reduce microbial levels.

Allowing continuous flow of all carcasses into the chilling system after application of an antimicrobial solution prior to hydro-cooling should result in a reduction of microbial levels on all carcasses. Within individual approved facilities, the procedure will initially be tested on carcasses from young chickens, on one production line, during one specified production period. Upon adequate demonstration of the effectiveness of the combined systems, the testing procedures will then be expanded (within individual plants) to all processing lines, for all shifts.

2. Literature Review

The current regulations allow any poultry carcass accidentally contaminated during slaughter with digestive tract contents to be reprocessed at an approved reprocessing station away from the main processing line. This removal of visible contamination may be accomplished by vacuuming, washing, or trimming in any combination. (9CFR 381.91). In addition to removal of visible defects during this off-line process, the other major concern is control of pathogenic organisms that may be spread to the finished product by digestive tract contents. Several research articles have indicated that the levels of aerobic bacteria, *Enterobacteriaceae*, *Escherichia coli* and *Salmonella* were not significantly different on conventionally processed carcasses and those taken off-line reprocessed due to digestive tract content contamination. (J. Food Protection 56:11, pages 983-985): (1995 J. Appl. Poultry Res. 4:23-31) (J. Food Sci. 40: 1236-1238). A process may be designed so that both visible contamination standards are met and, so that the microbiological qualities of the off-line

processed birds and the on-line processed birds are not statistically significantly different. This process would consist of Inside/Outside bird washers to remove visible contamination and a spray cabinet to deliver an anti-microbial treatment such as Sanova (acidified sodium chlorite) prior to entering the chill systems. The Sanova anti-microbial rinse solution is a "one time" use solution that is not re-circulated. This process method could be used to eliminate the need to move birds away from the main process line for the purposes of removing visible contamination thereby allowing them to remain on the main process line. This would lend to less handling and less opportunity for bacterial cross contamination.

A series of tests will be conducted at designated plants to determine the effectiveness of an enhanced carcass rinse/wash system for reduction of microbial levels and removal of intestinal tract contents from young chicken carcasses. This will be accomplished using 500-1200 ppm Sanova (as sodium chlorite) with a GRAS approved organic acid (citric acid). Chemical concentration and water pressures will be determined during the trial and incorporated into the procedure. The duration of the study is tentatively scheduled for 90 days to establish the sustainability of the procedure under commercial conditions.

3. Methodology and Procedure:

Inspectors will complete visual carcass inspection. All sample units (carcasses) will be removed from the evisceration line prior to chill for analysis. Sample units will be randomly selected and identified from the population of carcasses designated by the FSIS inspector for off-line reprocessing. Sample units will be identified (tagged) and marked with a permanent mark (for example, split tail) by the inspector's assistant. Daily samples will consist of a total of 40 carcasses per day.

- a) 10 identified and tagged carcasses for off-line re-processing will be removed from the evisceration line at point A as pre-process samples and subjected to a whole carcass rinse once /day (Figure 1).
- c) 10 identified and tagged carcasses at point A will be removed at point D as post-process samples and visually inspected once/day.

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- b) 10 identified and tagged carcasses at point A will be removed at point B as post-treatment samples for whole carcass rinse once/day.
- c) 10 identified and tagged carcasses at point D as pre-treatment samples will be removed for whole carcass rinse once/day.
- d) 10 identified and tagged carcasses from the re-processing station will be removed at point C as post-process samples for whole carcass rinse once/day.

The identified sample units will be removed from the evisceration line prior to entering the chill system and reprocessed according to approved re-processing practices. No carcass will be selected that is not suspended in the shackle by both legs.

During the initial period of evaluation, sampling will be conducted on one production line, during one specified production period, for 3 days per week over a four week period. Upon adequate demonstration of the effectiveness of the combined systems, the continuous on-line processing procedures will then be expanded (within individual plants) to all processing lines, for all shifts. During the subsequent two month period, a sampling schedule of one day per week with alternation between lines each week will be followed.

4. Sample Evaluation:

Visual:

The first 10 sample units (10 identified for reprocessing and tagged) will be collected after passing through the final wash station at point D and taken to an off-line re-inspection station. The re-inspection station will meet the requirement outlined in Poultry Regulation 381.36(C) (2) (iii) (iv). These sample units will be examined for feces, using zero tolerance criteria for accept/reject of the subgroup. The same 10 sample units will be examined using pre-chill processing criteria for accept/reject of the subgroup (extraneous material).

Microbiological:

The solution resulting from the whole carcass rinses at points B, C, and D will be collected and used to quantify generic *Escherichia coli* plate counts by AOAC Method 991.14. *Salmonella* analysis will be accomplished using AOAC Method 986.35, ELISA presumptive screen and USDA LC-75, incidence (Appendix 2).

This proposed continuous on-line re-processing procedure combines an improved carcass wash/rinse with an antimicrobial solution. The Sanova Acidified Sodium Chlorite process has already been found to be effective in controlling both *Salmonella* spp. and *Escherichia coli* on poultry carcasses and has been approved for this use by USDA. (Appendix 1). The analysis of generic *Escherichia coli* is used due to its ability to indicate presence of fecal material as accepted by FSIS. The primary function of off-line reprocessing is to ensure removal of intestinal tract contents.

5. Evaluation Sites:

Specific detail on the sites to be included in this evaluation program will be provided in the near future.

6. Product Safety:

§ 171. (c) (E) of Secondary Direct Food Additive Petition 4A4433 contains information on the "Safety of the Acidified Chlorite/Chlorous Acid System." A complete copy of the above Food Additive Petition may be found with the Documents Control Branch of FDA.

7. Worker Safety:

Work place safety will be an essential ingredient of all processing plant testing. At no time will safety be compromised for FSIS inspection personnel or processing plant employees. § 171. (c) (E) of Secondary Direct Food Additive Petition 4A4433 contains information on the

"Safety of the Acidified Chlorite/Chlorous Acid System." A complete copy of the above Food Additive Petition may be found with the Documents Control Branch of FDA.

8. Environmental Safety:

§ 171.1 (c) (H) of Secondary Direct Food Additive Petition 4A4433 contains information on the "Environmental Assessment" of the Alcide ASC solutions. A complete copy of the above Food Additive Petition may be found with the Documents Control Branch of FDA.

9. Inspection Procedures:

It is not anticipated that there will be any interference with or hindrance to normal USDA visual inspection of slaughter operations as a result of either the application of Alcide ASC solutions or the monitoring of the various parameters to be measured.

10. Conclusion

Cross contamination is reduced by minimizing carcass handling, by minimizing contamination levels on carcasses entering the hydro-coolers and by ensuring accelerated carcass chilling. A combination of the above factors can be provided by a continuous on-line re-processing system as proposed in this protocol. Such a system should ultimately lead to improvements in product safety and quality.

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Microbiological Test Procedures

Sample Preparation:

1. All samples will be kept at ≤ 50 degrees Fahrenheit following collection.
2. Analyses of samples must begin the day following sample collection.
3. At each sample time, broiler carcasses will be taken individually from the processing line. Information on date of collection and individual sample identification will be recorded on each sample bottle.
4. Each individual carcass will be transferred to a sterile "stomacher" bag, draining any excess fluid.
5. 400 ml of Butterfield's Phosphate Diluent (BPD) will be added to each carcass contained in the sterile stomacher bag and the carcass will be rinsed inside and out with a rocking motion for one minute (ca. 35 RPM). This will be done by grasping the broiler carcass with one hand and the closed top of the bag with the other then rocking with a reciprocal motion in a 18 - 24 inch arc, assuring that all surfaces (interior and exterior of the carcass) are rinsed.
6. The rinse solutions from each stomacher bag will be transferred to sample bottles and information on date of collection and individual sample identification will be recorded on the bottle label. Each bottle will be placed in a styrene container with dry ice for over night delivery to the testing laboratory.

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Sample Analyses:

On the day of sample receipt, quantitative determinations for Escherichia coli will be initiated. Qualitative determinations for Salmonella spp. will also be initiated. The methodologies to be followed for these tests are as follows:

E. coli counts - AOAC, 991.14, Petrifilm.

Salmonella - AOAC 986.35, ELISA presumptive screen.

Salmonella - USDA LC-75, incidence.

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