KOSOVO NEW OPPORTUNITIES FOR AGRICULTURE PROGRAM

LETTUCE VALUE-ADDED PACKAGED BAGGED SALADS TECHNICAL ASSISTANCE

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DISCLAIMER
This report was prepared by the New Opportunities for Agriculture project team of Tetra Tech ARD based on a Final Report prepared by Short Term Technical Advisor, Devon Zaggory, a Farmer to Farmer volunteer. The authors' views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

CONTENTS

CONTENTS 1

BACKGROUND 2

PURPOSE OF ASSIGNMENT 3

EXECUTIVE SUMMARY 3

FIELD ACTIVITIES TO ACHIEVE PURPOSES 5

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTIVITY 7

ANNEXES 9

ANNEX 1 – CONTACT LIST 9
ANNEX 2 – STANDARD OPERATING PROCEDURES (SOPS) 2
ANNEX 3 – FOOD SAFETY INFORMATION 8
ANNEX 4 – LIST OF SUPPLEMENTARY MATERIALS 21

BACKGROUND

USAID supports economic growth in Kosovo through programs that strengthen and improve the competitiveness of Kosovar agribusinesses, improve the business environment, and encourage local economic development. Accordingly, USAID/Kosovo has awarded Tetra Tech ARD the task order for the New Opportunities in Agriculture in Kosovo Program.

The goal of NOA is to increase economic growth in Kosovo through expanded, environmentally sustainable production and sales of value-added agricultural products by enabling producers and processors to compete regionally and globally. NOA has the following components:

1. Products and farmers linked with markets:
2. Agriculture products diversified and increased;
3. Food quality and safety improved;
4. Increased affordable and accessible credits;
5. Improved coordination with the agriculture sector.

As lettuce is a targeted sector for the program, NOA aims to contribute to the development of diversified and increased agriculture production through the introduction of new lettuce varieties, extending the harvest and post-harvest shipping season, and introducing value-added bagged lettuce salads for both retail and food service sales.

Lettuce demand in Kosovo is increasing, and bagged lettuce salads recently introduced by the NOA program have shown good market acceptance and demand over the past year. The program has recently installed a small-scale pilot bagged lettuce processing plant at Agro-Serra, which was grant-funded on a cost shared basis. The company is preparing to pack bagged lettuce salads for both retail and food service customers. NOA also introduced iceberg, romaine, endive, baby leaf lettuces, arugula and Savanova type lettuces to Kosovo lettuce farmers and value-added processors during the past year of programming. As the program moves forward, the focus will be on bridging gaps in the lettuce value chain through the following initiatives: introduction of pre-cooling of lettuce, cold chain requirements for bagged value added lettuce, improving quality control, standard sanitary procedures and developing a raw product and finished goods specifications for the Kosovo bagged lettuce processors. There is currently no pre-cooling system for lettuce in Kosovo, and it is not being practiced in the value chain. Therefore, icing will be introduced as a pre-cooling method and modified atmosphere packaging (MAP) to meet the cold chain requirements in order to increase shelf life of packaged salads.

PURPOSE OF ASSIGNMENT

The purpose of this assignment was to develop the quality control capacity and sanitary standards for the local value-added lettuce processor Agro Serra in order to extend the shelf life to enable the penetration of local and regional export markets. Through this assignment, Agro Serra should obtain a clear understanding of how to manufacture and produce at least four different bagged salad products for local and regional markets.

Tasks

- Increase the shelf life of domestically-produced fresh cut lettuce using icing and MAP technology;
- Train lettuce processors on both active and passive new MAP technologies involving oxygen transmission rates (OTR) for four different packaging films, quality control, measuring optimal gas concentrations and leak detection to produce extended shelf life (targeted at 14 days);
- Trial-test four different types of bagged lettuce films for shelf life extension, such as chopped iceberg bag (target weight 350 grams) with an OTR 135 using an oriented poly propylene (OPP) bag, romaine lettuce salad bag (target weight 325 g) OTR 250 using an OPP bag, shredded iceberg salad bag foodservice (target weight 2.2 kg) OTR 300-330 using a Linear Low Density Polyethylene (LLDPE) bag, and spring mix bag (target weight 175g) using a micro perforation bag 1 inch spacing between perforations, 20 gauge needle, penetration through both sides of bag (front and back) using an OPP bag- with all bags to be sealed using an impulse sealer;
- Develop sanitation standard operating procedures (SSOP) and plant production standard operating procedures (SOP) for processing each of the four bagged products; and
- Develop raw product and finished goods specifications for the four different packaged salads.

Deliverables

1. Develop written sanitation standard operating procedures (SSOP) and plant production Standard Operating Procedures (SOP) for processing each of the four bagged products.
2. Develop written raw product and finished goods specifications for the four different packaged salads.
3. Trail test the four different bags for shelf life extension.
4. Establish written quality control standards that will enhance the marketability of the products.
5. Provide a written technical report.
6. Debrief USAID, Program Staff, MAFRD and other interested parties.

EXECUTIVE SUMMARY

Kosovo soils and climate are appropriate for growing lettuce and other leafy greens, and fresh greens are an important part of the national and regional diets. However, the varieties grown and current handling practices restrict the post-harvest life and marketability of greens that have been grown in Kosovo. The NOA program introduced several new, more appropriate varieties of leafy greens to farmers in Kosovo, and they are currently being grown on a limited but expanding basis. The current lettuce handling practices in Kosovo, characterized by a lack of cooling capacity and appropriate packaging, limit the shelf and marketability of leafy greens. The NOA program brought Devon Zagory Ph.D. as a short-term technical expert to work with the grower Agro Serra to develop its capacity to cool, process, package and distribute value-added bagged lettuce salads.

Agro Serra had installed a small industrial slicer/shredder, an ice making machine, a salad washing unit designed to use ice to chill the wash water, a centrifugal dryer, a sorting and weighing table, an impulse sealer, an immersion package seal testing apparatus, and a package head space gas tester. None of the equipment had been used prior to the assignment. We successfully got the equipment working smoothly and properly calibrated. We ascertained the appropriate settings for the equipment for selected leafy greens and for the available packaging films. We then developed standards and procedures for evaluating the quality and shelf life of the packaged greens. Using those evaluation methods, we then developed a detailed process for creating a series of modified atmospheres inside packages for the purpose of evaluating the best combination of oxygen and carbon dioxide to promote quality and shelf life. We established several series of test packages with different leafy greens and mixes of greens for evaluation over two weeks to determine how best to package each salad type. Finally, we developed cleaning and sanitation procedures for equipment, floors, drains, walls, ceilings and bins. We discussed validation technologies for sanitation processes, including ATP Luminometer technology.

FIELD ACTIVITIES TO ACHIEVE PURPOSES

Field Visits

Prior to Dr. Zagory's arrival, Agro Serra had already installed a small industrial slicer/shredder, an ice making machine, a salad washing unit designed to use ice to chill the wash water, a centrifugal dryer, a sorting and weighing table, an impulse sealer, a immersion package seal testing apparatus, and a package head space gas tester. The tools and equipment were brand new and of very high quality. However, none of them had yet been turned on or used.

Equipment Setup: With the assistance of Ismet Babaj, Vegetable Production Specialist at NOA, we were able to get the equipment working smoothly and properly calibrated. We determined the best settings of each machine for the different greens and blends of greens, including washing times/temperatures, centrifugal dryer settings and impulse sealer packaging machine settings. We tested the impulse sealer with each of the different film types and with vacuum, gas flush and both vacuum and gas flush in order to assure that it was working properly and providing adequate gas-tight seals. We recorded the settings and developed SOPs for properly setting the equipment for each package/product combination, including the following:

SOP#1 Daily Pre-Op Inspection of Package Sealing Machine
SOP#2 Monthly Maintenance of Package Sealing Machine
SOP#3 Time and Temperature Evaluations and Optimization
SOP#4 Chilling Wash Water
SOP#5 Calibration of Centrifugal Dryer
SOP#6 Process for Determining Package Configuration

Quality Evaluations: In order to encourage continuous improvement in everyday operations, it is essential to measure results. We have therefore encouraged and facilitated measurement of many different indicators, including temperature of lettuce at harvest, time from harvest to arrival at the processing facility, temperature of lettuce upon arrival at the processing facility, quality of the lettuce upon arrival at the processing facility, temperature of the water used to chill the lettuce, and quality of the lettuce at various times up to the end of shelf life. We have provided evaluation logs for each of these measurements and encourage measurement, analysis of the measurements and archiving of measurement logs for future comparisons.

Package Evaluations: Modified atmosphere packaging (MAP) is a complex technology that can be beneficial to product quality and shelf life; however, when used inappropriately it can be counterproductive and actually reduce shelf life. For this reason we went to some lengths to explain the basis of MAP, the relationship of plant physiology and film transmission rates, and the all-important role of temperature management in achieving the benefits of MAP. Finally, we developed a detailed procedure for package fabrication and evaluation in order to determine the optimal package conformation for each salad type. Since Dr. Zagory would not be in Kosovo long enough to monitor the package development efforts, he developed and demonstrated the methodology to Mr. Babaj, who will assist with ongoing package development.

Food Safety: The safety of any food product introduced into the market is critical. Due to the longer shelf lives and MAP of value-added salads, there may be additional risks not normally associated with field-grown lettuce. Food safety assurance must be ongoing and focused on every step of growing, harvesting, processing, packaging and distributing. Because there is no "kill step" available for fresh lettuce, the prevention of contamination with microorganisms are the primary concerns. Once contaminated with microorganisms, washing in sanitizing solutions cannot reliably decontaminate lettuce or other leafy greens. The primary sources of microbiological contamination are human and animal faeces, human handling, and cross-contamination from contaminated tools or equipment. In order to encourage vigilance, we developed procedures for several food safety activities, including a pre-harvest evaluation for animal faeces or animal activity in the fields, sanitation standard operating procedures for the processing room and equipment, lists of major food safety concerns in fields and processing areas, food safety training materials, check lists for tasks completed, and informational supporting materials. In addition we had extensive discussions with the owner of Agro Serra, Mr. Hajzeri, about the importance and practice of food safety. As Kosovo progresses into exporting value-added salads, food safety certification will become necessary. The European food safety standard protocol, Global GAP, will likely come into play. In our view at this time it is premature to embark on the complexities of the record keeping necessary for Global GAP certification, but attention to areas of potential contamination and prevention of contamination should be the first task, and will form the basis for attention to Global GAP in the future.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTIVITY

The physical resources are in place to start to produce high-quality bagged salads in Kosovo, and there appear to be ready markets for the products. Agro Serra is a capable and willing partner and leader in this sector. There are several advantages that they already enjoy. First, they have installed very high-quality equipment. In addition, Mr. Hajzeri is an excellent farmer producing very high quality leafy greens as his primary product. His team is enthusiastic about the prospects for the business and they clearly are eager to work hard to realize success. In their first week, they are producing bagged salads that look very good and will almost certainly achieve shelf lives far exceeding what is currently available in Kosovo.

At the same time, there are challenges ahead:

1. Coordinating the many moving parts in a fresh-cut processing operation is not easy. Ensuring that seedlings are planted in the proper amounts at the proper time so that there is a continuous supply of the right amounts of the right greens is very challenging. Due to the vagaries of the weather and biological uncertainties, it is wise to always plant excess in case some plantings exhibit too many defects or suffer from disease or any number of other problems. This commitment to supply chain quality represents a new way of thinking and may take time to implement.
2. Making measurements, recording measurements, and evaluating those numbers to drive continuous improvement also appears to be a new concept. We have provided templates and procedures, but the drive to implement these systems must come from the operators. Whether they will embrace this remains to be seen.
3. Maintenance of quality and shelf life depends to a great extent on proper temperature management. Bagged salads will reach their greatest potential if continuously held at or near 0ºC. While this ideal may be unrealistic, the drive to approach it will largely determine the quality and export potential of these products. Top icing is a suboptimal method of temperature management because it relies mainly on conduction of heat from the product to the ice, a slow process. Moving refrigerated air is preferred because it relies on convection and movement of warm air away from the product. Refrigerated trucks, refrigerated cases at retail and refrigerated walk in coolers in restaurants will ultimately be necessary for the fresh-cut sector to reach its' full potential.
4. Modified atmosphere packaging is a complex and delicate technology that can deliver significant benefits but if misused will rapidly degrade quality. We have developed a process to evaluate and optimize the use of the packaging, but the process is rather complex and it may not receive a high priority during the day-to-day operations. Future periodic reevaluations of the packaging and its management may be necessary to ensure that the packaging is working for, and not against, the goals of the business.
5. Food safety is not an event, but rather a process. The process needs to be learned, implemented and followed every day and in every aspect of the operation. In addition, many buyers, particularly in the international community, require evidence of active food safety programs in the form of food safety audit certification. In Europe and many other parts of the world the *de facto* farm-level protocol is Global GAP. Global GAP certification can be complicated and requires extensive record keeping. We have set Agro Serra on the very beginning of the path to food safety certification through provision of information and implementation of food safety

processes. After these initial processes become embedded into Agro Serra's operations, they will require additional assistance to take further food safety steps.

6. The implementation of the many interactive processes necessary to successfully produce bagged salads relies not only on good primary products, good equipment, enthusiasm, and hard work- it also requires thorough understanding of the basis of the technologies and the processes so that problems can be analyzed and processes altered as necessary. While short-term technical experts have a role to play, the future of value added horticulture in Kosovo will rely on capacity building within the country. There are two short courses offered each year at the University of California, Davis that have achieved world-wide renown. There is a two-week course in June each year that focuses on post harvest handling of fruits, vegetables and ornamental crops. The first week consists of lectures by leading experts in specific topics, and the second week is a field trip around California to see the technologies implemented in an industrial setting. The second course takes place each September and lasts three days. It focuses on fresh-cut processing and all of the technologies associated with cut and bagged products. Of the two courses, the post-harvest handling course would be the most useful for the Kosovo context. Ismet Babaj and Reshat Ajvazaz may be good candidates to be sent to the post harvest course to bring back the insights that they receive and to better disseminate that knowledge within Kosovo and other Balkan countries.
7. Agro Serra has made a very good start in processing salads for the Kosovo market. The next step will be developing markets and coordinating production to feed those markets. Estimates of their maximum throughput range from 200-400 kg/day. It is as of yet unclear if the local market can absorb that production. If it can, and the market continues to grow, Agro Serra will need additional equipment to increase production. The major bottleneck to greater production is the impulse sealer. It takes about 10-25 seconds to seal a bag, which limits the rate at which finished products can be made.
8. The result of this project is that Agro Serra has the equipment and know-how to make good quality bagged salads. The maximum shelf life remains to be determined, but initial samples reflect excellent quality seven day post production. Since the maximum post harvest life of lettuce in Kosovo has been considered to be two days, this is a significant improvement. Incremental improvements in quality, productivity, safety and shelf life are possible with the current physical plant. In order to realize these improvements, Agro Serra will have to measure, record and analyze their processes in order to understand where improvements can be made. We have provided the processes for doing so, but it is unclear if they will follow those processes. Like most young businesses, they are focused on production issues and getting the most product out in the shortest time possible. It may be wise to revisit Agro Serra in 6-7 months to evaluate their progress and to assist in implementing additional improvements.

ANNEXES

Annex 1 – Contact List

Name	**Company**	**Contact**
Gani Hajzeri	Agro Serra	ganihajzeri@agroserra.com
Liza Marku	NOA Project	lmarku@noakos.com
Ismet Babaj	NOA Project	ibabaj@noakos.com
Michael Kimes	NOA Project	mkimes@noakos.com
Reshat Ajvazaj	NOA Project	rajvaza@noakos.com

Annex 2 – Standard Operating Procedures (SOPs)

SOP#1: IMPULSE SEALER DAILY PREOPERATION INSPECTION:

The daily operating routine should include a visual inspection before and after the use of the sealer. Both the operator and maintenance personnel should note odd sounds and electrical or mechanical problems.

DAILY CHECK AND INSPECTIONS:

1.	**CHECK**	All settings, times and pressures as per setup procedure.
2.	**CHECK**	Seal-covers for good condition.
3.	**CHECK**	For accumulation of dust or particles in Seal Head area.
4.	**CHECK**	Air-Filter, clean and drain if necessary.
5.	**CHECK**	For loose or misaligned parts.
6.	**CHECK**	For unusual operation or sounds.

SOP#2: IMPULSE SEALER MACHINE MONTHLY MAINTENANCE:

The monthly inspection routine should include a visual inspection before and after the use of the sealer. Both the operator and maintenance personnel should not odd sounds and electrical or mechanical problems.

DAILY CHECK AND INSPECTIONS:

1.	**CHECK**	Perform daily check.
2.	**PM***	Clean machine as necessary using a mild detergent and water.
3.	**PM**	Apply spray lubricant or similar light static free lube to moving linkage, heads and bearings.
4.	**CHECK**	Visual inspection for electrical/mechanical integrity.
5.	**CHECK**	All Process Controls for consistent performance.
6.	**CHECK**	For unusual operation or sounds.

*PM = Preventative maintenance

SOP #3: TIME AND TEMPERATURE EVALUATIONS AND OPTIMIZATION

PROCEDURE:

1. Using a temperature probe measure and record the time and the ambient air temperature at the beginning of harvest.
2. Using an infrared temperature gun measure and record the product temperature at the beginning of harvest.
3. Measure and record the time and the ambient air temperature at the end of harvest.
4. Measure and record the product temperature at the end of harvest.
5. Measure and record the temperature in the cold room at the beginning of harvest.

6. Measure and record the temperature of the cold room at the end of harvest.
7. Measure and record the time and the temperature of the greens immediately prior to going into the wash water.
8. Measure and record the time and the temperature of the wash water immediately prior to putting greens in the water.
9. Measure and record the temperature of the greens immediately after washing.
10. Measure and record the temperature of the wash water immediately after washing.
11. Evaluate the recorded measurements to look for excessive warming or slow movement.

SOP #4 CHILLING WASH WATER

Prior to startup, assure that the wash water is properly chilled to ~2ºC.

PROCEDURE:

1. Fill the wash tank with ice.
2. Add water to the proper volume.
3. Turn on the circulating pump to mix the water and ice until the water is < 2ºC.
4. Measure and record the temperature of the water in the chiller.
5. Add more ice if necessary to bring the temperature to ~2ºC.
6. Weigh and record weight the lettuce or other product to be washed.
7. Measure and record the temperature of the lettuce before placing in the chilled water.
8. Place the lettuce in the chilled water while the circulating pump is operating.
9. Remove samples of lettuce after 1 minute, 2 minutes, 3 minutes and 4 minutes.
    a. Measure and record the temperature of the lettuce immediately upon removal from the water.
    b. Measure and record the temperature of the water in the wash tank each time a sample is removed.
    c. Determine the time necessary to cool the lettuce to <5C as a function of the weight of the lettuce and the initial temperature of the lettuce.
    d. Develop curves demonstrating these relationships and use them to determine the time necessary to cool each product as a function of initial temperature.

SOP#5: CALIBRATION OF CENTRIFUGAL DRYER

PROCEDURE:

1. Record the weight of the full bin of leafy greens upon removal from the wash water.
2. Place the bin in the centrifugal dryer.
3. Set the speed at the lowest setting.
4. Spin for 1 minute.

5. Record the weight of the bin.
6. Remove a sample of lettuce, evaluate the wetness and look for any signs of physical damage such as breakage, bruising or discoloration.
7. Replace the lettuce sample in the bin
8. Spin the lettuce for one more minute.
9. Repeat the process above until the weight does not change or there is visible deterioration of quality.
10. The previous spin time should then be set as optimal for the given product.
11. If the leafy greens are still too wet, then repeat the process with the speed set at the next highest setting.

SOP#6 PROCESS FOR DETERMINING THE OPTIMUM PACKAGE CONFIGURATION

Pertinent Variables:

1. OTR = Oxygen transmission rate, or the rate at which the film allows oxygen to pass through the film. This is a characteristic of individual films.
2. Respiration rate (R) = The rate at which the lettuce or other leafy greens breathe. They consume oxygen (O_2) and produce carbon dioxide (CO_2) in approximately equal amounts. It is expressed as ml/kg-hr of O_2 produced or CO_2 consumed. This is inherent to the type of product at a given temperature. R increases rapidly as temperature increases.
3. Weight (W) of the product = Kg of product in the bag. The more product, the more respiration occurs so more O_2 is consumed and more CO_2 is produced.
4. Surface area (A) of the plastic film = The more square meters of film (m^2) the more O_2 and CO_2 will pass through the film.
5. Film thickness (T) = the Gauge or thickness of the film, in millimeters.
6. O_2 concentration in air is ~20.9%
7. CO_2 concentration in air is ~0.4%
8. Relationship among the variables:

At a constant temperature:

$$\frac{OTR = (R*W*T)}{[A*(O_{2air}-O_{2package})]}$$

This equation shows that, to achieve a specific desired O2 concentration in the package:

- If the respiration rate of the product is high, the OTR will have to be high to achieve a given equilibrium O2 concentration.
- If you put more product in the package, the OTR will have to be higher.
- If the plastic film gets thicker, the OTR will have to be higher.
- Of the bag gets larger (more surface area), the OTR can be lower.

How can we use these relationships:

- The respiration rate of individual products and product mixes is fixed at a

given temperature.

- We need to estimate the temperature that the packaged products will experience during distribution and marketing. Typical temperatures might be ~5-10C.
- Shelf life will be much longer at 5C than at 10C. The longest shelf life would be at 0C, but it is not reasonable to expect such perfect temperature management.
- The variables that we can manipulate are the size of the package and the amount of product that we put in the package. The package size is often fixed, so manipulating the amount of product is usually the best option.

9. By varying the amount of product inside packages we can generate a series of atmospheres using the same film and the same product.

- Make packages of the selected product that contain different amounts of the same product
  -For example, 500gm/package, 400gm, 300gm, 200gm and 100gm
  -If the commercial package becomes anaerobic, use weights less than what is in that commercial package
- Make at least three replicate packages for each product weight for headspace analysis, and additional packages for quality evaluations
- Gas flush sample packages to immediately establish an atmosphere
- Place the packages at the appropriate test temperature
- Place a septum on each of three packages to use for withdrawing headspace gas samples
- Starting on day 1, and continuing until the end of shelf life, measure the headspace O_2 and CO_2 every day for three packages for each package weight
- Starting on day 6 evaluate the quality of samples for each package weight for each film
- Note the symptoms of quality loss (i.e. loss of turgor, off odor, limpness, etc.)
- Identify those packages that result in the best quality and shelf life
- Note the equilibrium O_2 and O_2 concentrations in those best packages
- Graph the results for easier interpretation
- Having identified the desired O2 concentration that results in the best quality and shelf life, input that amount (for 2% O_2 input 0.02) into the above equation and solve for the weight of product that will give that atmosphere.
- If that weight is not feasible, input the desired package weight and solve for package size.

SOP#6: WATER USED TO MAKE ICE

Water used to make ice should be potable and free of *E. coli* and/or fecal coliforms. Show analysis or results of *E. coli* test.

Explanation: Ice made from contaminated water can then contaminate large quantities of product. Melting ice is a very good medium for spreading pathogens. For this reason, it is critical that the water used to make ice does not contain pathogens. Presence of *E. coli* is an indicator of fecal contamination and the possible presence of human pathogens.

ACTIONS:

1. If using city water to make ice, obtain a copy of an analysis of the water that contains results of a test for *E. coli* or fecal coliforms. Put a copy in the food safety binder for reference.
2. If buying ice, obtain a copy of an analysis of the water from the company that makes the ice. Make certain that the analysis contains results of a test for *E. coli* or fecal coliforms. Put a copy in the food safety binder for reference.
3. If making ice from water sourced on site, test the water for presence of *E. coli*. If the water contains *E. coli*, either sanitize the water with chlorine or other sanitizer to eliminate *E. coli*, or use a different, pure source of water.
4. Maintain records of measurements and addition of sanitizers.

SOP#7 ADDITION OF ACID AND BLEACH FOR WATER USED IN CONTACT WITH FRESH PRODUCE

PROCEDURE:

1. Measure the pH of the water that will be used wash the product.
2. If the pH is above 7.0, add citric acid to the water to bring the pH down to a range of 6.0 – 7.0.
    a. Take one liter of water.
    b. Measure 5 ml of citric acid and add to the water.
    c. Mix the water and citric acid and measure the pH.
    d. Continue the procedure until the pH goes below 7.0
    e. Write down how much citric acid was used to bring the pH down.
    f. In the future, multiply the amount of citric acid for one liter times the number of liters to be treated and add that amount to the water.
3. After adjusting the pH, where necessary, add the appropriate amount of bleach, as indicated in the table below.
4. Measure pH and chlorine concentration with test kit, paper test strips or ORP meter to confirm that pH and chlorine activity are correct.

Tank Capacity (Liters)	Bleach Needed (ml)	Concentration of Chlorine (ppm)
25	50	100
50	100	100
100	200	100
200	400	100
300	600	100
400	800	100
500	1,000	100
1000	2,000	100
2000	4,000	100
3000	6,000	100

Bleach often comes as a 5.25% solution. If the bleach is not 5.25%, an adjustment must be made to ensure adequate concentration is achieved.

Tank Capacity (Gallons)	Bleach Needed (oz)	Concentration of Chlorine (ppm)
25	6.4	100
50	12.8	100
100	25.6	100
200	51.2	100
300	76.8	100
400	102.4	100
500	128	100
1000	250.6	100
2000	501.2	100
3000	768	100

Bleach often comes as a 5.25% solution. If the bleach is not 5.25%, an adjustment must be made to ensure adequate concentration is achieved.

Annex 3 – Food Safety Information

Farm and Ranch Food Safety and Sanitation	
1.	Toilets are available, clean and supplied with toilet paper, water, soap and paper towels. They are within ½ kilometer or 5 minutes of workers
2.	Workers are trained in the importance and proper technique of hand washing
3.	Workers actually wash their hands after using the bathrooms
4.	Workers are trained in food safety and personal hygiene
5.	Sick workers or workers with symptoms of food borne illness are not allowed to work in food contact positions
6.	Water used for product contact, such as sprays or irrigation water, is assured to be free of *E. coli*
7.	Domestic animals and their waste are prevented from entering fields
8.	If manure or compost is used, it has been verified to be free of pathogens
9.	Bins and packaging materials are maintained free of rodent, bird and animal feces or other contamination
10.	Harvest tools and product contact surfaces are cleaned and sanitized according to a written schedule and written procedures

Fresh-Cut Processor Safety and Sanitation	
1.	Raw product was produced following GAP's (Good Agricultural Practices)
2.	Toilets are available, clean and supplied with toilet paper, water, soap and paper towels.
3.	Workers are trained in the importance and proper technique of hand washing and actually wash their hands after using the bathrooms
4.	Workers are trained in food safety and personal hygiene
5.	Sick workers or workers with symptoms of food borne illness are not allowed to work in food contact positions
6.	Water used for product contact, in tube coolers or for ice is assured to be free of E. coli
7.	There are written schedules and procedures for cleaning and sanitizing lines, equipment, floors, ceilings, drains, cooling units, drip pans, ice makers, etc. and signed checklists document that they are being followed
8.	There is a current log or documented evidence of a pest control program by an outside contractor or company personnel and there is no evidence of pests in or around the facility
9.	Good Manufacturing Practices (GMP's) are being followed and documented
10.	There is a trace/recall program and it has been tested

Food Safety and Hygiene Training

Microorganisms and Food Handling

- The microorganisms that cause illness are much too small to see.
- These tiny bacteria, viruses and parasites can be transferred to foods from dirty hands or blood, especially from people who did not wash his/her hands after using the toilet.
- We all eat fruits and vegetables and we can all be made sick if our food has been touched by somebody else who is sick or does not have clean hands.
- Don't eat food or chew tobacco or gum while working with fruits or vegetables. Food from our mouths can transfer bacteria or parasites to food and make others sick.
- These microorganisms may also be in the soil, so any product that is dropped on the ground should be discarded.

Illness Reporting

- Report any active cases of illness to your supervisor before beginning work. This includes diarrhea, vomiting, fever, or nausea. Seek medical attention and do not handle fruits or vegetables!
- Report lesions on your body, such as infected wounds, draining wounds, boils or wounds seeping pus that might come in contact with produce. Obtain gloves to cover the wound or do NOT handle produce!
- Be familiar with symptoms of infectious diseases so that if symptoms are evident the supervisor can take appropriate steps.
- Symptoms include diarrhea, runny nose, yellow skin or eyes, cough or fever.

Toilet Use

- All employees must use the toilet facilities provided that they are connected to a sewage disposal system or are a self-contained field toilet.
- Failure to use provided toilet facilities may be grounds for dismissal.
- Never take gloves into the toilet. Hang them outside before entering.

Hand Washing

- All employees must wash their hands with soap and water at the beginning of the workday, after using the toilet, after eating, before entering the work area and any other time that their hands may have become contaminated. Failure to do so may be grounds for disciplinary actions and eventual dismissal.
- Hand washing includes the following steps:
    - Wet hands thoroughly
    - Lather with soap
    - Rub soap on hands for at least fifteen seconds
    - Be sure to wash the tips of the fingers
    - Rinse soap off
    - Dry hands with clean, disposable paper towels
- Dry hands with clean, disposable paper towels
- If reusable gloves are used to handle produce, then, after washing hands, gloves must be washed with soap and water at the beginning of the workday, after using the toilet, after eating, after leaving the work area and any other time that the gloves may have

become contaminated.

Bleeding Incidence

- Any cuts or scrapes that cause the loss of blood must be reported to the supervisor immediately.
- All products that may have come in contact with blood during an incident must be destroyed.
- All equipment that has come in contact with blood during this incident must be cleaned and sanitized before being used again.

Food-Borne Illness Training for Supervisors

There are six main food borne illness organisms that are known to be able to contaminate food via infected food handlers. Supervisors should be aware of the symptoms of these food borne illnesses so that they can recognize them in workers. If any food handlers appear to exhibit symptoms of any of these illnesses, they should be sent to the doctor for diagnosis and should, under no circumstances, be allowed to continue to work in contact with food until a negative diagnosis has been returned or the symptoms abate.

Salmonella

Associated foods:
Raw meats, poultry, eggs, milk and dairy products, fish, shrimp, frog legs, yeast, coconut, sauces and salad dressing, cake mixes, cream-filled desserts and toppings, dried gelatin, peanut butter, cocoa, and chocolate. Outbreaks on melons, tomatoes, alfalfa sprouts, orange juice (probably due to use of manure in field).

Where it comes from:
Fecal contamination, contact with infected workers, contaminated water, and manure.

Infectious dose:
As few as 15-20 cells; depends upon age and health of host, and strain differences among the members of the genus. It is estimated that from 2 to 4 million cases of salmonellosis occur in the U.S. annually.

Target Populations:
All age groups are susceptible, but symptoms are most severe in the elderly, infants, and the infirm. AIDS patients suffer salmonellosis frequently (estimated 20-fold more than general population) and suffer from recurrent episodes.

Nature of Disease:
Acute symptoms -- Nausea, vomiting, abdominal cramps, minimal diarrhea, fever, and headache.

Chronic consequences – arthritic symptoms may follow 3-4 weeks after onset of acute

symptoms.

Onset time -- 6-48 hours.

E-Coli

Associated foods:
Undercooked or raw hamburger (ground beef) has been implicated in nearly all documented outbreaks and in other sporadic cases. Raw milk was the vehicle in a school outbreak in Canada. Un-pasteurized apple juice. Other meats may contain *E. coli* O157:H7.

Where it comes from:
E. coli is a normal inhabitant of the intestines of all animals, including humans. When aerobic culture methods are used, *E. coli* is the dominant species found in feces. Normally *E. coli* serves a useful function in the body by uppressing the growth of harmful bacterial species and by synthesizing appreciable amounts of vitamins. A minority of *E. coli* strains are capable of causing human illness by several different mechanisms. *E. coli* serotype O157:H7 is a rare variety of *E. coli* that produces large quantities of one or more related, potent toxins that cause severe damage to the lining of the intestine. A recent outbreak in apple juice was probably from apples picked up off ground with fecal contamination. Also has been found on melons, iceberg lettuce, red cabbage, leaf lettuce, Mesclun mix, carrots (maybe). Strain (O157:H7) is usually associated with meat. When found on produce it is probably from cross contamination in the kitchen or from manure or animals in the field.

Infectious dose:
Unknown, but from a compilation of outbreak data, including the organism's ability to be passed person-to-person in the day-care setting and nursing homes, the dose may be similar to that of Shigella spp. (10 organisms).

Target Populations:
All people are believed to be susceptible to hemorrhagic colitis, but larger outbreaks have occurred in institutional settings.

Nature of Disease:
The illness is characterized by severe cramping (abdominal pain) and diarrhea, which is initially watery but becomes grossly bloody. Occasionally vomiting occurs. Fever is either low-grade or absent. The illness is usually self-limited and lasts for an average of 8 days. Some individuals exhibit watery diarrhea only.

Shigella

Associated Foods:
Salads (potato, tuna, shrimp, macaroni, and chicken), raw vegetables, milk and dairy products, and poultry. Contamination of these foods is usually through the fecal-oral route. Fecally contaminated water and unsanitary handling by food handlers are the most common causes of contamination. Outbreaks on lettuce from contaminated raw materials, probably in the field. Has been found on scallions, perhaps through use of non-potable water.

How it gets around:
Most often through contaminated food handlers or contaminated water.

Infectious dose:
As few as 10 cells depending on age and condition of host. The *Shigella* spp. are highly infectious agents that are transmitted by the fecal-oral route.

Relative Frequency of Disease:
An estimated 300,000 cases of shigellosis occur annually in the U.S. The number attributable to food is unknown, but given the low infectious dose, it is probably substantial.

Target Populations:
Infants, the elderly, and the infirm are susceptible to the severest symptoms of disease, but all humans are susceptible to some degree. Shigellosis is a very common malady suffered by individuals with acquired immune deficiency syndrome (AIDS) and AIDS-related complex, as well as non-AIDS homosexual men.

Symptoms:
Abdominal pain; cramps; diarrhea; fever; vomiting; blood, pus, or mucus in stools.

Onset time -- 12 to 50 hours.

Staphylococcus aureus:

Associated foods:
Foods that are frequently incriminated in staphylococcal food poisoning include meat and meat products; poultry and egg products; salads such as egg, tuna, chicken, potato, and macaroni; bakery products such as cream-filled pastries, cream pies; sandwich fillings; and milk and dairy products. Foods that require considerable handling during preparation and that are kept at slightly elevated temperatures after preparation are frequently involved in staphylococcal food poisoning.

How it gets around:
Staphylococci exist in air, dust, sewage, water, milk, and food or on food equipment, environmental surfaces, humans, and animals. Humans and animals are the primary reservoirs. Staphylococci are present in the nasal passages and throat and on the hair and skin of 50 percent or more of healthy individuals. This incidence is even higher for those who associate with or who come in contact with sick individuals and hospital environments. Although food handlers are usually the main source of food contamination in food poisoning outbreaks, equipment and environmental surfaces can also be sources of contamination with *S. aureus*. Human intoxication is caused by ingesting enterotoxins produced in food by some strains of *S. aureus*, usually because the food has not been kept hot enough (60C, 140F, or above) or cold enough (7.2C, 45F, or below).

Infectious dose:
The disease is caused not by infection by the bacterium but rather by ingestion of a toxin formed by the bacterium in food. A toxin dose of less than 1.0 microgram in contaminated food will produce symptoms of staphylococcal intoxication. This toxin level is reached when *S. aureus* populations exceed 100,000 per gram.

Target population:
All people are believed to be susceptible to this type of bacterial intoxication; however,

intensity of symptoms may vary.

Symptoms:
The onset of symptoms in staphylococcal food poisoning is usually rapid and in many cases acute, depending on individual susceptibility to the toxin, the amount of contaminated food eaten, the amount of toxin in the food ingested, and the general health of the victim. The most common symptoms are nausea, vomiting, retching, abdominal cramping, and prostration. Some individuals may not always demonstrate all the symptoms associated with the illness. In more severe cases, headache, muscle cramping, and transient changes in blood pressure and pulse rate may occur. Recovery generally takes two days. However, it is not unusual for complete recovery to take three days and sometimes longer in severe cases.

Hepatitis A

Associated Foods:
HAV is excreted in feces of infected people and can produce clinical disease when susceptible individuals consume contaminated water or foods. Cold cuts and sandwiches, fruits and fruit juices, milk and milk products, vegetables, salads, shellfish, and iced drinks are commonly implicated in outbreaks. Water, shellfish, and salads are the most frequent sources. Contamination of foods by infected workers in food processing plants and restaurants is common.

How it gets around:
Contaminated water, sewage, infected food handlers. Hepatitis A has a worldwide distribution occurring in both epidemic and sporadic fashions. About 22,700 cases of hepatitis A representing 38% of all hepatitis cases (5-year average from all routes of transmission) are reported annually in the U.S. In 1988 an estimated 7.3% cases were foodborne or waterborne. HAV is primarily transmitted by person-to-person contact through fecal contamination, but common-source epidemics from contaminated food and water also occur. Poor sanitation and crowding facilitate transmission. Most individuals 18 and older demonstrate an immunity that provides lifelong protection against reinfection. In the U.S., the percentage of adults with immunity increases with age (10% for those 18-19 years of age to 65% for those over 50). The increased number of susceptible individuals allows common source epidemics to evolve rapidly.

Target Population:
All people who ingest the virus and are immunologically unprotected are susceptible to infection. Disease however, is more common in adults than in children.

Nature of Disease:
Hepatitis A is usually a mild illness characterized by sudden onset of fever, malaise, nausea, anorexia, and abdominal discomfort, followed in several days by jaundice. The infectious dose is unknown but presumably is 10-100 virus particles.

Norovirus

Associated Foods:
Seafood, especially undercooked clams and oysters, salads.

How It Gets Around:
Previously known as Norwalk-like viruses. These viruses are common causes of food and water borne gastrointestinal illness. They move easily through a fecal-oral route and are associated with poor personal hygiene. Norwalk gastroenteritis is transmitted by the fecal-oral route via contaminated water and foods. Secondary person-to-person transmission has been documented. Water is the most common source of outbreaks and may include water from municipal supplies, well, recreational lakes swimming pools, and water stored aboard cruise ships. Shellfish and salad ingredients are the foods most often implicated in Norwalk outbreaks. Ingestion of raw or insufficiently steamed clams and oysters poses a high risk for infection with Norwalk virus. Foods other than shellfish are contaminated by ill food handlers.

Nature of Disease:
The disease is self-limiting, mild, and characterized by nausea, vomiting, diarrhea, and abdominal pain. Headache and low-grade fever may occur. The infectious dose is unknown but presumed to be low. A mild and brief illness usually develops 24-48 hours after contaminated food or water is consumed and lasts for 24-60 hours. Severe illness or hospitalization is very rare. Shedding of the virus is thought to begin with the beginning of symptoms and may continue for up to two weeks after symptoms recovery. For further information see the attached Technical Fact Sheet from the Centers for Disease Control.

Discharges from the Eyes, Nose, and Mouth

Discharges from the eyes, nose, or mouth through persistent sneezing or coughing by food employees can directly contaminate exposed food, equipment, utensils, linens, and single-service and single-use articles. When these poor hygienic practices cannot be controlled, the employee must be assigned to duties that minimize the potential for contaminating food and surrounding surfaces and objects.

Source: U.S. Food & Drug Administration, Center for Food Safety & Applied Nutrition, Foodborne Pathogenic Microorganisms, and Natural Toxins Handbook. Bad Bug Book. www.fda.gov

DAILY PRE-OPERATION INSPECTION FORM

Week of:							
PRE INSPECTION	SUN	MON	TUE	WED	THU	FRI	SAT
Shipping, Cold Rooms, Receiving Area							
Floors swept, broken pallets removed							
Walls and ceilings, overhead pipelines, fans – cleaned and free of cobwebs							
Trash cans emptied							
Rodent and insect stations clear							
Drains in good condition							

Perimeter around building clear							
Chemical & Cleaning Supply Storage							
Floors swept, walls and ceilings – cleaned and free of cobwebs							
All equipment and chemicals cleaned and properly stored							
Restrooms and Break Area							
Sinks, toilets, soap and hand towel dispensers stocked and working properly							
Trash cans emptied							
Mirrors cleaned							
Toilet tissue in holders							
Initials							

SANITATION STANDARD OPERATING PROCEDURES (SSOPs)

Before any cleaning and sanitizing tasks are performed all vegetables should be removed from the area or covered to protect them from splashing water and from cleaning compounds. All motors and electrical elements should be covered to protect them from water.

Washing and Sanitizing Food Contact Surfaces and Equipment
(Bin Dumps, Cutting Tables, Cutting Boards, Dispensers/Fillers)

Goal: Ensure the cleanliness of all food contact surfaces and equipment. Ensure that equipment does not become a source of contamination of product.

Frequency: Daily
Procedures:

1. Dismantle equipment
2. Thoroughly rinse equipment and food contact surfaces, from top to bottom, until all loose sludge, bits and pieces have been removed.
3. Mix soap as follows: _____
4. Apply soap.
5. Scrub vigorously with a stiff brush to remove small pieces and to remove invisible residues and films.
6. Rinse thoroughly a second time to remove all of the soap. The soap must be rinsed in order for the sanitizing solution to be effective.
7. Mix chlorine sanitizer as follows: _____
8. Spray all equipment and food contact surfaces with the sanitizing solution.
9. Write the time and date and sign the sanitation log for each individual piece of equipment or food contact surface. If any piece of equipment or surface area does not pass inspection, note that in the log and the crew must re-wash and re-sanitize that piece of equipment or surface until it passes inspection.

Washing and Sanitizing Trash Cans

Goal: Ensure cleanliness of trash cans to ensure that they do not act as a source of cross-contamination to vegetables.

Frequency: Daily or after each use

Procedures:

1. Rinse with a hose until all loose sludge, bits and pieces have been removed.
2. Mix chlorine-based soap as follows: _____
3. Spray on chlorine soap.
4. Scrub vigorously with a brush and rinse.
5. The Sanitation Crew Chief then inspects the trash cans and writes the time and date and signs the sanitation log. If any trashcans do not pass inspection, the crew chief notes that in the log and the crew must re-wash the trash cans until they pass inspection.

Washing Loading Docks and Main Cooler

Goal: Ensure the cleanliness of docks to ensure that filth does not accumulate and become a source of contamination of product.

Frequency: Weekly

Procedures:

1. Sweep with a broom to remove dirt and debris.
2. Thoroughly rinse with water until all loose sludge, bits and pieces have been removed.
3. Mix soap as follows: _____
4. Apply soap.
5. Scrub vigorously with brushes to remove small pieces and to remove invisible residues and films.
6. Rinse thoroughly a second time to remove all of the soap.
7. The Sanitation Crew Chief then inspects all washed surfaces and writes the time and date and signs the sanitation log. If any surface area does not pass inspection, the crew chief notes that in the log and the crew must re-wash the surface until it passes inspection.

Sanitation of Processing Room Floors

Goals: Prevent buildup of contaminants on floors that could cross-contaminate product.

Frequency: Daily.

Procedures:

1. Mix soap as follows: _____
2. Apply soap to floor.
3. Scrub vigorously to remove invisible films.
4. Rinse thoroughly to remove all of the soap. The soap must be rinsed in order for the

sanitizer solution to be effective.

5. Mix sanitizer solution as follows: _____
6. Alternate sanitizing solutions quarterly between Quat-based and chlorine-based formulations.
7. All of the floors must be sprayed with the sanitizer solution.
8. The Sanitation Crew Chief then inspects all sanitized floors and writes the time and date and signs the sanitation log for floors. If any floor does not pass inspection, the crew chief notes that in the log and the crew must re-wash and re-sanitize that wall until it passes inspection.

Sanitation of Processing Room Walls

Goals: Prevent buildup of contaminants on walls that could cross-contaminate product.

Frequency: Quarterly.

Procedures:

1. Mix soap as follows: _____
2. Apply soap to walls.
3. Scrub vigorously to remove invisible films.
4. Rinse thoroughly to remove all of the soap. The soap must be rinsed in order for the sanitizing solution to be effective.
5. Mix sanitizer solution as follows: _____
6. Alternate sanitizing solutions quarterly between Quat-based and chlorine-based formulations.
7. All of the walls must be sprayed with the sanitizer solution.
8. The Sanitation Crew Chief then inspects all sanitized walls and writes the time and date and signs the sanitation log for walls. If any wall does not pass inspection, the crew chief notes that in the log and the crew must re-wash and re-sanitize that wall until it passes inspection.

Sanitation of Ceiling, Pipes, and Leaks from Ceiling

Goals: Prevent buildup of contaminants on walls that could cross-contaminate product.

Frequency: Twice yearly.

Procedures:

1. Mix soap as follows: _____
2. Apply soap to ceiling.
3. Scrub vigorously to remove invisible films.
4. Rinse thoroughly to remove all of the soap. The soap must be rinsed in order for the sanitizing solution to be effective.
5. Mix sanitizer solution as follows: _____
6. Alternate sanitizing solutions quarterly between Quat-based and chlorine-based formulations.
7. All of the ceilings and pipes should be sprayed with the sanitizer solution. The sanitizing solution is applied with a backpack sprayer or other equipment.

8. The Sanitation Crew Chief then inspects all sanitized ceilings and pipes writes the time and date and signs the sanitation log for ceilings. If any ceiling area does not pass inspection, the crew chief notes that in the log and the crew must re-wash and re-sanitize that area until it passes inspection.

Washing and Sanitizing Cooling Coils and Drip Pans

Goal: Ensure the cleanliness of coils to ensure that *Listeria monocytogenes* does not become established and become a source of contamination of product.

Frequency: Twice per year

Procedures:

1. Remove Drip pans
2. Rinse coils with a hose until all dirt, dust and grease has been removed.
3. Mix quaternary ammonium sanitizer as follows: _____
4. Spray sanitizer solution onto the coils.
5. Do not rinse sanitizer off the coils!
6. Remove drip pans.
7. Mix soap as follows: _____
8. Apply soap to drip pans.
9. Scrub vigorously to remove invisible films.
10. Rinse thoroughly to remove all of the soap. The soap must be rinsed in order for the sanitizing solution to be effective.
11. Spray drip pans with quaternary ammonium sanitizer
12. The Sanitation Crew Chief then inspects all sanitized surfaces and writes the time and date and signs the sanitation log. If any coil or drip pan does not pass inspection, the crew chief notes that in the log and the crew must re-wash and sanitize the surface until it passes inspection.
13. Replace drip pans.

Washing Bathrooms

Goal: Ensure cleanliness of employee areas to ensure that they do not act as a source of cross-contamination between workers.

Frequency: Daily or as necessary.

Procedures:

1. Rinse with a hose until all loose sludge, bits and pieces have been removed.
2. Mix chlorine-based soap as follows: _____
3. Spray on chlorine soap.
4. Scrub vigorously with a brush and rinse.
5. The Sanitation Crew Chief then inspects all washed surfaces and writes the time and date and signs the sanitation log. If any area does not pass inspection, the crew chief notes that in the log and the crew must re-wash the surface until it passes inspection.

Note: Always clean bathrooms last!

Sanitation of Drains

Goals: Prevent buildup of contaminants (especially *Listeria monocytogenes*) in drains that could cross-contaminate product.

Frequency: Weekly or as necessary.

Procedures:

1. Remove all grates and coverings over drains.
2. Remove and dispose of all debris in the drains.
3. Rinse drains and drain coverings to remove loose debris.
4. Mix chlorine-based soap as follows: _____
5. Apply soap to drains and drain coverings.
6. Scrub drains and drain coverings vigorously with brushes to remove invisible films.
7. Rinse thoroughly to remove all of the soap. The soap must be rinsed in order for the sanitizing solution to be effective.
8. Mix quaternary ammonium sanitizer solution as follows: _____
9. Irrigate all drains and spray (or soak) coverings with the sanitizer solution.
10. Replace grates and drain coverings.
11. The Sanitation Crew Chief then inspects all sanitized drains and writes the time and date and signs the sanitation log for drains. If any drain does not pass inspection, the crew chief notes that in the log and the crew must re-wash and re-sanitize that wall until it passes inspection.

Washing Dumpster and Waste Disposal Areas

Goal: Ensure cleanliness so that waste disposal areas do not act as a source of contamination of product.

Frequency: Weekly or when emptied.

Procedures:

1. Rinse dumpster with a hose until all loose sludge, bits and pieces have been removed.
2. Mix foaming chlorine-based cleaner as follows: _____
3. Spray on foaming chlorine cleaner.
4. Scrub with a large brush and rinse again.
5. The Sanitation Crew Chief then inspects all washed surfaces and writes the time and date and signs the sanitation log. If any refuse area does not pass inspection, the crew chief notes that in the log and the crew must re-wash the surface until it passes inspection.

Procedure for Washing and Sanitizing Field Bins or Buckets

Goal: Ensure cleanliness of field bins or buckets to ensure that they do not act as a source of cross-contamination to vegetables.

Frequency: Daily or after each use

Procedures:

1. Rinse with a hose and potable water until all loose sludge, bits and pieces have been removed.
2. Mix chlorine-based soap as follows: _____
3. Spray on chlorine soap.
4. Scrub vigorously with a brush and rinse with potable water.
5. The Sanitation Crew Chief then inspects the bins or buckets.
6. The Sanitation Crew Chief writes the time and date and signs the sanitation log. If any bins or buckets do not pass inspection, the crew chief notes that in the log and the crew must re-wash them until they pass inspection.

Annex 4 – List of Supplementary Materials

- Lettuce Processing Flow Chart
- Specialty Salad Physiology
- Equilibrium Gas Concentrations as a Function of Product Weight
- Process Equipment Settings for Vegetable Varieties
- Setting up a Listeria Exclusion and Testing Program
- Sources for ATP Testing Devices
- Developing a Recall Plan
- Log for Chemicals, etc.
- Daily Pre-Operation Inspection Form
- Preharvest Inspection Procedure
- Check Sheet for Cleaning Tasks
- Water Sanitary Survey
- Hygiene Supplies
- Wash Water Sanitation
- ATP vs Micro Swab Testing

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