Food Safety for Enhanced Asparagus Competitiveness
Asparagus is a member of the lily family. It is one of the few temperate perennial vegetables. The enduring plant part is the crown, from which roots and new shoots (spears) emanate. The mature foliage, or “fern”, is needed to replenish energy reserves in the crown for future growth. The species has separate male and female plants. Males are preferred because they tend to be more vigorous over time. Since the spear is short lived, problems are few.
**Brief History of Asparagus**

Thought to be native to Middle East and Central Asia

Domesticated in Mediterranean region

About 2,000 – 3,000 years ago

Widely cultivated in Egyptian agrarian cultures

“Rediscovered” in 17th century by Louis XIV

In the late 19th and early 20th centuries, most asparagus was canned or frozen

Resurgence of fresh asparagus with more cold storage

Currently grown in the U.S. (CA, WA, MI), Mexico, Peru, France, Germany, China

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**Asparagus Nutrient Content**

(%RDA/serving = 180 g)

- Vitamin K: 114.6
- Folate: 65.7
- Vitamin C: 32.0
- Vitamin A: 19.5
- Tryptophan: 15.0
- Vitamin B1: 14.5
- Vitamin B2: 14.0

Plus 13 others

Calories: 43

Renowned for positive health effects on heart, cancers, joints, digestion, hypertension
The total global market for asparagus is expanding at an average of 5% per year based on total volume. In the Western Hemisphere, land area in the U.S. has fallen steadily since 2000 and in 2005, was surpassed by Peru. The global leader in asparagus production, however, is China.

Technical advances have implicated lapses in the U.S. food production and distribution system with regard to food-borne pathogens and toxins. To date, incentives to enhance food safety assurance has come mainly from end users and government. Opportunities exist for growers, packers, and processors to devise new systems and tools for food safety that will distinguish them from competitors.
Escherichia coli 0157:H7
Salmonella typhimurium
Listeria monocytogenes

Processing of canned and brined perishables imposes heat and chemicals that kill harmful bacteria that can persist in fresh and frozen fruits and vegetables. In the 1970s and 1980s, strides were made to limit pesticide residues in food products. Over the past 20 years, advances in microbiology and molecular biology have highlighted the roles of enteric bacteria such as *E. coli* 0157:H7, *Salmonella* sp., *Listeria monocytogenes*, and others in food borne illnesses.

Outbreaks of food borne illnesses have been highly publicized over the past 20 years, and led to massive product recalls and a restructuring of the industry.
Over the past 20 years, food industry associations and retailers have developed requirements for growers to adhere to, with backup from government agencies.

With the passage of the Food Safety Act of 2010, the role of government in the food safety assurance system will increase.

In general, whole vegetables, such as asparagus spears, are subject to fewer concerns and regulations than are pre-cut and packaged vegetables.
The “Good Agricultural Practices” (GAP) document is a statement of farming procedures for minimization of food safety risks on your farm. “Good Manufacturing Practices” and “Good Handling Practices” are summaries of all the procedures in the packing shed that also accomplish a reduction in the risk of food safety problems such as pathogens, toxins, and foreign objects.
“Hazard and Critical Control Point” (HACCP) is a valuable concept in food safety process management. Times and locations in the overall growing or packing process that are the most vulnerable are identified, and measures are taken to address these vulnerabilities.

Food safety and the farm: Environmental assessments and risk reduction. Factors that are considered are topography, hydrology, geographical features, climatic conditions, land history, adjacent land use, and wildlife.
Food safety and the farm: Water quality management and evaluation. Factors to be considered in assessing water include endemic pathogen loads and method of irrigation.

Food safety and the farm: Soil quality management and monitoring. Factors that raise concerns are composted animal wastes and forces that affect human pathogens such as pH, compaction, cover crops, and rotation intervals.
Food Safety and the farm: Harvesting method. Both machine and hand harvesting can introduce human health hazards. Factors to consider include the design and maintenance of equipment and human hygiene.

Food safety and the farm: Human contact with crop surfaces. The hands of workers, visitors and other field personnel are infested with pathogens. Hygiene and the use of gloves is recommended.
Special requirements for gloves: The GAP or GMP should spell out procedures for use of gloves. These procedures should be followed and documented. There are specific recommendations for disposable and reusable gloves.

Food safety and the farm: Special considerations for foreign objects. The GAP and GMP should define measures to exclude foreign objects from food products. Training manuals and programs should emphasize these procedures.
Food safety and the farm: Equipment contact with crop surfaces. Farm equipment will come in contact with soil, soil amendments and contaminants, and human flesh, so may spread human pathogens. Procedures are needed to use equipment in a rational way and sanitize after use.

Food safety and the farm: Special considerations for flooding. Waters that exceed normal boundaries may come into contact with pathogens and other contaminants. Measures are necessary to exclude any crops exposed to flood waters from the food supply.
Food safety and the farm: Use of agricultural water for crop hydration. Any water used to control dust on plant surfaces prior to harvest must be subjected to a rigorous quality testing program.

Food safety and the farm: Precautions and treatments for reuse of field harvesting containers. Re-use provides the potential for cross-contamination of food products. Containers should be sanitized, stored, and transported in a manner that is consistent with unadulterated food. Damaged containers should be removed from the food transport chain.
Food safety and the farm: Documentation and records. Most importantly, accurate records must be kept to allow for the traceback of packed and shipped products to specific facilities and conditions, to harvesting dates, crews, and equipment, and to the specific field. Certain operational records are also recommended by FDA. Examples include written food safety plans and SOPs for handling and storage practices; field, facility, and vehicle sanitation; employee training programs; and others.

Food safety and the farm: Cooling methods. Any water used in postharvest operations may contaminate asparagus and other leafy vegetables. One suggestion is to use virgin water in cooling, not recycled even with filtering or disinfection. Procedures must ensure water quality and equipment operating effectiveness.
Food safety and the farm: Wash and cooling water treatment. The vulnerability of each water source and distribution system should be assessed regularly, and water should be tested close to the point of use at the prescribed frequency. All water storage tanks should be included in regular cleaning and sanitation operations. Levels of disinfesting agents such as chlorine should be monitored and adjusted, in addition to pH.

Food safety and the farm: Special considerations for MAP. The use of bulk bins under modified atmosphere process conditions has been shown to have the potential to introduce pathogens to leafy green vegetables, such as cored lettuce.
Food safety and the farm; packing: Procedures and worker training programs should be developed to prevent foreign objects from intruding on food products.

Food safety and the farm; packing: Basic hygiene of employees. All workers who contact food must exercise proper hygiene and use gloves.
Food safety and the farm; packing: Documentation and records pertaining to postharvest handling on file. Documents that should be retained in files include operations and equipment used in packing, storage, and shipping.

Additional considerations for value-added processing
Examples would include asparagus tips or spear pieces. Products are subject to additional regulations (21 CFR part 1.10).
Labeling for end users:

Products must be labeled to avoid end user confusion regarding whether a product needs to be washed prior to consumption. Examples include “washed” and “ready-to-eat”.

New technologies for shelf life extension: These advances may inadvertently provide habitats for human pathogens. When adopting new technology, food safety implications must be considered.
Food safety and the farm: New technologies for food pathogen detection. Advances in molecular biology and forensic science are making it possible to accurately detect and quantify food-borne pathogens in short time frames. Before investing in traditional technology in QA procedures, check markets for availability of PCR-based capabilities.

Packaging of finished products: Appropriate primary and secondary packaging must be used to maintain food integrity.
Food safety and the farm; Distribution: Condition and sanitation of transportation vehicles. If your company is involved in distribution, you are regulated by FDA (21 CFR 110.19)

Food safety and the farm; Distribution: It is crucial to monitor the temperature of products in the distribution network. Care should be taken not to introduce food safety concerns, such as by product package puncturing.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Condition</th>
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<tbody>
<tr>
<td>212°F</td>
<td>Cooking temperatures destroy most bacteria. Time required to kill bacteria decreases as temperature is increased.</td>
</tr>
<tr>
<td>165°F</td>
<td>Warming temperatures allow survival of some bacteria.</td>
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<tr>
<td>140°F</td>
<td>DANGER ZONE: Temperatures in this zone allow rapid growth of bacteria and production of toxins by some bacteria.</td>
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<tr>
<td>40°F</td>
<td>Cold temperatures permit slow growth of some bacteria that cause spoilage.</td>
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<tr>
<td>32°F</td>
<td>Freezing temperatures stop growth of bacteria but may allow bacteria to survive.</td>
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Product traceback continuity for potential recall

Arranging and preparing for a 3rd party audit: Your clients or state agricultural department or advocate such as Farm Bureau will have information on organizations and private companies approved to conduct third party food safety audits. You should contact the concern and ask for a summary of their needs. In general, you should have all records up to date and readily accessible, and be able to demonstrate how GAPs and GMPs relate to training programs and actual operations. You will probably be required to bear the cost of the audit.
The 3rd party audit: The auditor team will examine all records including traceback, operations, HACCP, GAPs, GMPs, and written training materials. Then they will inspect operations to assess food safety procedures and determine how well documents are actually followed. A score will be determined that is publically displayed on the auditor’s web site for potential clients to see.

The 3rd Party Audit: The development of a current and effective HACCP plan for your operation is critical to a successful 3rd party audit. Much of the analyses of food safety concerns will emanate from the HACCP plan.
The 3rd Party Audit: You should be able to fully demonstrate the quality of water at the source and following treatment. Records of coliform bacteria are most important.

The 3rd Party Audit: Employee food safety training program. This will include the manuals and a record of all trainings and logs signed by attending employees.
The 3rd Party Audit: Surface hygiene and contact temperatures. Maintain operations and records that demonstrate appropriate hygiene and temperature management.

The 3rd Party Audit: Pest management. A program for minimizing opportunities for animal and insect pest intrusion into operations is essential. Procedures should be fully documented, and a log of activities available to the auditor.
Product traceback continuity for potential recall

The 3rd Party Audit: Documentation of food safety program. Maintain records of everything. Maintain records of records!
The Food Safety Act of 2010

IN SUMMARY

What you should do…..?

• Develop a GAP and GMP as appropriate for each crop/product that is aimed at minimizing potential contact with antagonists (food pathogens, toxins, unlabeled pesticides, etc.)
  - Water quality
  - Soil quality and fertilization
  - Pesticide use and storage
  - Worker hygiene and training program

• The principles of HACCP should be used in developing these plans

• Arrange and prepare for a 3rd Party Audit annually
  - USDA (adequate) or Primus Labs (preferred)
  - Information management procedures
  - GAPs and GMPs complete and effective
  - Worker training program and manuals
  - Water testing and pesticide residue test results
  - Traceback records and procedures are robust
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