



Sprouts

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Introduction

Sprouts are the germinated seeds of various herba-ceous plants, including vegetables, herbs, and field crops. The entire germinated plant (root, shoot, coty-ledons, and remnant seed coat) is sold for use mainly in salads and sandwiches. Sprouting is considered a form of food processing, rather than agricultural crop production; as such, it is regulated by the U.S. Food and Drug Administration (FDA).

At first glance, the quick turnaround time of sprout production may be very appealing to growers. How-ever, producing sprouts is very labor-intensive and carries considerable risk. Foodborne illness outbreaks, traced back to contaminated sprouts, have caused sprout production to come under heavy scrutiny. The Food Safety Modernization Act (FSMA) contains regulations affecting sprout production practices, facilities, and marketing. Dates for sprouts produc-ers to comply with FSMA were earlier than dates for other produce growers; sprouts growers with at least \$25,000 in annual sales had to comply with Subpart M of the Produce Safety rule as of 2019. However, that figure is adjusted for inflation. As of April 2022, the cutoff point had increased to \$29,245. For details, see <https://www.fda.gov/food/food-safety-moderniza-tion-act-fsma/fsma-inflation-adjusted-cut-offs>. Mean-while, the FDA, in cooperation with the Institute for Food Safety and Health within the Illinois Institute of Technology, established the Sprouts Safety Alliance (SSA). The purpose of the SSA is to pro-vide support to the industry by identify-ing and implementing the best practices for safe production of sprouts.

Regardless of producer size, following



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guidelines established by the sprout industry, FDA, and SSA for the safe production of sprouts will be critical to successful sprout production. It is the pro-ducer's responsibility to be fully aware of the risks involved and how to follow pertinent laws and regula-tions. Refer to the [Institute for Food Safety and Health website](#) and the FDA publication [Guidance for In-dustry: Reducing Microbial Food Safety Hazards for Sprouted Seeds](#) for a summary of the risks and neces-sary precautions.

Marketing

Sprouts can be marketed at farmers markets and other direct-to-consumer outlets, as well as to local grocers, restaurants, and the gourmet and health food market. Larger market outlets for a processed crop, such as grocers and res-taurants, usually demand the processor deliver a continuous supply and quantity. Market outlets may also require sprout



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producers to adhere to even more stringent food safety standards. Consistent quantity, following food safety guidelines, and meeting product quality standards are all significant barriers for marketing sprouts.

Market Outlook

Sprouts are widely regarded as nutritious and therefore popular among health-conscious consumers. However, sprouts have been the source of several foodborne illness outbreaks in the U.S. The FDA considers sprouts a high-risk food and has cautioned individuals with weakened immune systems, including children, older adults, and pregnant women, against eating any variety of raw or lightly cooked sprouts. In addition, some restaurant chains limit serving sprouts due to food safety concerns. Despite these problems and concerns, sprouts remain in demand. Once dominated by alfalfa and bean sprouts, the market is more diverse and now includes other vegetable sprouts, such as adzuki beans, broccoli, peas, buckwheat, rye, and wheatgrass.



SUNFLOWER SPROUTS

Production Considerations

Microbial contamination issues

The most common pathogens involved in foodborne illnesses that have been traced back to sprouts are *Escherichia coli* and *Salmonella* spp. In addition, some sprouts have tested positive for the *Listeria monocytogenes* pathogen. All of these are potentially deadly. The likely source of these microorganisms is the contamination of seed prior to sprouting. Seeds are often produced without the knowledge that they are destined for the sprout market, thus precautions against contamination may not be taken. Contamination with the bacteria that cause foodborne illnesses can occur when seeds for sprout production come into contact with animal waste during production, harvest, transportation to the sprouting facility, or in storage. Raw manure applied to the field, grazing animals, and irrigation water are some of the possible sources of contamination during seed production.

Although bacterial levels present on the seed are gen-

erally very low and sporadic, the sprouting process provides such an ideal environment for the bacteria that they quickly multiply and contaminate the entire batch of sprouts. Bean sprouts, as well as other sprouts used in stir fry recipes, are less of a problem since they are cooked prior to consumption.

Obtaining, storing, and treating seed

Sprout producers should purchase seed that is free of pesticide seed treatments and grown using Good Agricultural Practices (GAP). Certified organic growers must use certified organic seed for edible sprouts production. The FDA, which proposed updated guidance for sprout seed production in 2019, recommends seeds be obtained only from suppliers with a good program for screening their product for potential contamination. Purchased seed bags should be examined for evidence of water damage and animal droppings; a black light can be used to detect evidence of animal urine contamination on bags. Seed should only be stored off the ground in a dry, rodent/bird/insect-free facility.

To reduce the threat of sprouts harboring human pathogenic bacteria, sprout producers should treat seeds with calcium hypochlorite prior to processing. This is deemed a more effective means of reducing contamination than attempting to treat the already germinated sprouts. While seed treatments have been shown to reduce bacterial contamination, the process is not 100% foolproof in eliminating harmful bacteria. Other techniques of decontamination, such as irradiating the germinated sprouts, are being researched, but these methods would require FDA approval before implementation by producers.

Crop selection

Seed from numerous herbaceous annuals and perennials can be used in sprout production. The most common are alfalfa and bean sprouts. Bean sprouts are generally produced from mung bean seeds, although other small-seeded beans (such as adzuki, navy, pinto, and soybean) have also been used. Sprout vegetable

crops include arugula, broccoli, cabbage, garlic, onions, peas, pumpkin, and radish. Other potential seed crops include dill, sesame, and sunflower. Wheatgrass is produced from various cereals, such as wheat, rye, and triticale. Consumer demand for an assortment of flavors (e.g. spicy to mild) as well as textures and colors, will determine what growers need to grow.

Facilities and processing

Sprouts are produced by placing seeds in a warm, moist environment until they have germinated to the desired size. Each seed crop will have its own temperature and soak time requirements, but many germinate in three to seven days. Facilities for production need to be equipped so that air and water temperature can be controlled. Supplemental lights may be required for sprouts in which green color (chlorophyll) development is in demand; however, greening is not desirable for all sprouts. Because cleanliness during production and harvest is so critical, all equipment and production areas must be made of rust-proof materials that can be easily sanitized daily. Workers need to wear the same sanitary gloves and gowns worn over clothing that is required in food processing facilities.

The FDA requires that sprouting facilities implement a [Hazard Analysis and Critical Control Point \(HACCP\) plan](#), which includes following [Good Manufacturing Practices \(GMPs\)](#). In addition, maintaining complete and accurate records is critical to being able to trace contaminated product back to its source. If foodborne illnesses do occur, the contamination must be traceable to specific products, distributors, or farmers. This means that recalls can be specific, rather than general blanket programs. Recordkeeping also helps growers establish that they executed due diligence in their production in the unlikely event that an outbreak is traced to their facility.

The specific methods and equipment for sprout production vary from one facility to another. In general, each batch of seed is first treated with a fresh solution of calcium hypochlorite and then rinsed several times with water. This is followed by a presoak for up to an hour to ensure seeds obtain a uniform moisture content. The pre-soaked seeds are drained and placed in sprouting containers where they are periodically sprayed with fresh water with the spent irrigation water drained off. Only potable water is used throughout the sprouting process. Seeds can be germinated in



RADISH SPROUTS

trays or in rotary drums using either manual or automated systems. If greening is desirable, germinating seeds are exposed to light near the end of the sprouting process.

Testing the spent irrigation water is another important means of ensuring the safety of the sprouts. This water, which has flowed over the sprouts during production, is a good indicator of the types of microbes that are present on the actual sprouts. The water can be collected by qualified personnel at the sprouting facility; however, the actual water tests should be conducted by an independent laboratory. Water for testing is generally sampled approximately 48 hours into the growing period (beginning at pre-soak), but may be collected up to 48 hours before the crop is harvested. Sufficient time needs to be allowed so that test results are returned prior to harvest. If the water tests positive for any human pathogenic bacteria, the entire batch of sprouts should be discarded.

Pest management

Decay bacteria, which develop rapidly during the moist conditions of sprouting, can be a major concern with pre- and post-germinated seeds. Prevention involves purchasing high quality seeds, seed treatment with calcium hypochlorite, following strict sanitation protocols during production, and proper storage of the harvested sprouts. Using chlorinated or ozonated irrigation water may also be helpful in reducing the incidence of seed decay.

Harvest and storage

Once sprouts have reached the desired size they are rinsed; in some cases, remnants of the seed coat are

also rinsed off. Excess water is removed using a centrifuge or similar equipment. Sprouts are packaged for retail sales in clear clamshell containers. Immediate and continued refrigeration is essential for maintaining product quality from harvest to end-market.

Labor requirements

Labor hours will vary considerably based on size and automation of the sprout production system, but even small-scale sprout production is very labor-intensive. In addition to production labor, there are significant management hours required for designing the production facility to meet safety requirements, monitoring sprout production, and ensuring safe handling and delivery of the products.

Economic Considerations

Sprouts production is classified as a food processing enterprise; such ventures can require large capital expenses. Initial investments for sprout production include facility and equipment expenses. Production training or consulting fees may be a large expense for beginning growers wishing to maximize production and quality. Food safety-related expenses, such as the time spent developing a HACCP plan and determining GMPs, testing irrigation water used for sprout production, and personnel training costs are other substantial expenses. Commercial sprouts production is highly automated, and small-scale production will require the grower to obtain premium prices for profitability. Product liability insurance is another expense that will be incurred by sprouts growers. Growers should consult with a financial professional or develop a detailed profit and loss projection based on their experience and desired scale before launching an enterprise with a greater potential for production risks.

Selected Resources

- Guidance for Industry: Reducing Microbial Food Safety Hazards in the Production of Seed for

Sprouting (FDA, 2019) <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/draft-guidance-industry-reducing-microbial-food-safety-hazards-production-seed-sprouting>

- FSMA Final Rule on Produce Safety <https://www.fda.gov/food/food-safety-modernization-act-fsma/fsma-final-rule-produce-safety>
- Sprout Safety Alliance <https://www.ifsh.iit.edu/ssa/resources>
- Validated test kits for microbial testing of spent irrigation water during sprout production (Sprout Safety Alliance, 2011) https://www.ifsh.iit.edu/sites/ifsh/files/departments/ssa/pdfs/ifsh2011_sproutaudit_app_b.pdf
- Safer Processing of Sprouts — Modules (California Department of Public Health, Food and Drug Branch and U.S. Food and Drug Administration Center for Food Safety and Applied Nutrition) Note: scroll down web page to Produce Food Safety (Sprouts) http://postharvest.ucdavis.edu/Library/Video_Library/
- Sprouts and Wheatgrass Production and Marketing (ATTRA, 1999) <https://attra.ncat.org/product/sprouts-and-wheatgrass-production-and-marketing/>
- Sprout Production in California (University of California, 2002) <https://anrcatalog.ucanr.edu/pdf/8060.pdf>
- Selecting and Serving Fresh Produce Safely (Scroll down to “Sprouts: What You Should Know” (FDA, content current as of Feb. 17, 2022) <https://www.fda.gov/food/buy-store-serve-safe-food/selecting-and-serving-produce-safely>

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