



# FOOD TECHNOLOGY FACT SHEET

## Adding Value to OKLAHOMA

405-744-6071 • www.fapc.biz • fapc@okstate.edu

### Reduction of Drying Time for Jerky Products

**Timothy J. Bowser**  
FAPC Food Process Engineer

**Jacob Nelson**  
FAPC Value-Added Meat Processing Specialist

**Stacey J. Kowalski**  
FAPC Research Assistant

Jerky manufacturing is a time-consuming process because meat must be dried slowly at a relatively low temperature. Dehydration time varies from processor to processor and depends on many variables such as dehydrator temperature setting, humidity control, jerky slice thickness and equipment configuration. Some dehydration cycles that include a lethality step take more than 12 hours. Processors may be able to reduce production costs and increase product throughput by reducing dehydration times. The objective of this fact sheet is to report on three factors that have been identified and proven to reduce dehydration time without drastically affecting the final product (Bowser, et al. 2009).

#### Three Factors That Can Reduce Jerky Drying Time

The three factors that can reduce drying time are (in order of importance):

1. Chemical tenderization
2. pH
3. Product orientation

Tenderization helps to break down the fibers of the meat product creating more avenues for moisture to escape during the dehydration process. Many tenderizers will probably work, but Bowser et al. (2009) used a liquid papain product (Liquipanol T-100, Enzyme Development Corp., New York) that was applied at the rate of 1 mg of tenderizer per pound of meat. The tenderizer was added to the marinade and the jerky was allowed to sit for 1 hour at 40°F. All of the marinade was soaked up by the jerky.

Adjustment of raw product pH may help dehydrate the meat more rapidly because of a unique physical property called the isoelectric point. The isoelectric point is the pH value (5.2) at which meat products hold the least amount of moisture. A small amount of vinegar was added to the marinade to adjust the pH to the isoelectric point.

Orientation of product may have a significant effect on dehydration time. Research results indicate that vertical orientation is the best. Products with a vertical orientation may dry faster because free water runs off the surface, rather than accumulating on a horizontal surface. This is especially important during high-humidity pasteurization processes that many jerky manufacturers are now using. Most jerkys can be hung vertically by hooks, draped across supports or pierced by and hung on a support.

Reducing the cost of the jerky dehydration process decreases the overhead cost for a food plant facility. This adds more profit directly to the bottom line.

Examples of areas in the dehydration process that can be examined to reduce cost include:

- out-of-specification product (rework or waste)
- air leaks or excessive air flow
- inefficient fuel use
- inefficient electric motors
- heat loss
- heat waste
- over-dehydration
- underutilization
- downtime
- inefficient startup and shutdown procedures

#### The Oklahoma Cooperative Extension Service Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; home economics; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of Cooperative Extension are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and based on factual information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

Restructured jerky products do not permit handling prior to dehydration and must be oriented horizontally and fully supported by trays.

Virtually any processor will be able to test one or more of the factors to speed up their manufacturing process. The three factors are fairly simple to implement – but some might be inappropriate for a specific product and production process used by a given manufacturer. For instance, orientation does not make sense if the product cannot be physically manipulated into a vertical position (e.g. extruded jerky) or if vertical placement results in unacceptable cosmetic changes in the final product. Tenderizer might not be an acceptable ingredient in an organic, natural, premium product.

### Five Steps to Reduce Jerky Drying Time

Reducing drying time can add dollars directly to the profit of your operation by reducing the cost of energy and increasing product throughput. Five steps to take to reduce jerky drying time are:

1. Analyze the drying process and equipment. Develop an understanding of the following:
  - a. Requirements for processing and materials handling.
  - b. Product attributes.
  - c. Type of equipment.
  - d. Product/process safety.
2. Identify the factors (tenderizer, pH and orientation) that can be successfully applied to the product without upsetting the production system or negatively affecting the final product.
3. Implement the factors identified in step 2.
4. Track results.
5. Adjust factors and production system to make continuous improvements.

The five steps are described further below.

#### 1. Analyze the Drying Process and Equipment

A solid understanding of the drying process and equipment is needed.

- How is the meat treated prior to dehydration? Can any of the factors (e.g. tenderizer and pH adjustment) be added during the marinade or mixing process without extra work?

- Will the final product be negatively affected

by the addition of tenderizer or an acid? Can the product be dried in a vertical orientation without negatively affecting the final appearance and feel of the product?

- Will the equipment accommodate process changes to add liquids to adjust pH or a tenderizer? Can the product be supported in a vertical orientation without sacrificing capacity and increasing preparation time?

#### 2. Identify the Factors that Successfully Can Be Applied to Your Product

Based on an analysis of the drying process and equipment, which factor(s) can be applied to the dehydration process? Tenderization can change product texture, which may affect physical properties like tear strength and mouth-feel. Changes can be viewed positively or negatively. Tenderizer may permit the use of a less expensive grade of meat that was previously rejected because of toughness. Adjustment of pH may result in some flavor change; but other ingredients could be added to offset acid tartness and improve final flavor. Bromelain (a tenderizer) is an example of a potential ingredient that may be classified as a nutraceutical that promotes joint health; therefore, increasing the appeal of the final product for a target audience (any label statement would require supporting evidence). Also, the ingredient statement must be considered when identifying factors, since the tenderizer, acidifier and any additional ingredients must be included on the label.

#### 3. Implement the Factors Selected

Put the new ideas to work by trying them out in a limited production run or in a portion of a production run. Experimentation does not need to be expensive and risky. Try new factors on a single tray or rack of product; using the natural divisions within your process equipment (e.g shelves) to subdivide the treatment.

#### 4. Track Results

Keep careful records of everything done to modify the product and compare results to the standard. If the dehydration time of the standard product is not well documented, this activity must

be undertaken as well. Overall drying times should decrease significantly and permanently because of the treatment(s).

#### 5. Make Continuous Improvements

The activity of recording the results of the dehydration processes will help to identify areas of improvement or to determine if something has changed. When changes have occurred, the five-step process can be reiterated to solve new problems. The process of making incremental changes for the best is called “continuous improvement.” Data collected should include (but is not limited to): date, drying time, product identification, operator, yield, outdoor conditions (temperature and relative humidity) and any unusual observations (e.g. non uniform drying, special weather conditions like hail or sleet, power failures and personnel changes). Use continuous improvement activities to look for patterns that might show cause and effect, like propped open doors in the processing room that allow more fresh air to enter into the dehydrator, reducing drying time.

#### Food safety

Dehydrators often are used to achieve a critical control point (CCP) for food safety. A reduction in dehydration time should not affect food safety of jerky products as

**“Jerky drying is an age old process, but we’re constantly learning new things that can be applied to improve it.”**  
– Tim Bowser  
FAPC Food Process Engineer

long as an approved lethality step is included in the dehydration process. See fact sheet FAPC-165 Consistent Lethality Treatment for Small-Scale Jerky Dehydrators for additional information on this topic.

#### Conclusion

As energy, labor and equipment prices continue to rapidly increase; the efficiency of a jerky dehydration system is becoming more important. Reducing jerky drying time can result in increased cash flow and improved product quality. Modifications in the process and final product may be needed, but when properly implemented, changes will be classified as improvements.

#### References

Bowser, T.J., R.S. Frazier, P.R. Weckler, S.J. Kowalski. 2009. Optimizing jerky drying time with minimal product impact. submitted to The Open Food Science Journal, Bentham Science Publications, www.bentham.org/open/index.htm.,



Figure 1. Beef jerky hanging in a dehydrator from two wire hooks (thermocouple wire is visible in top center of photo).



Figure 2. Beef jerky slices on horizontal racks in a dehydrator.