Water Activity for Meat and Poultry Jerky

Meat and poultry jerky, a popular snack, is a dried shelf-stable product. Preparation of jerky usually consists of 5 steps, namely: 1) strip preparation, 2) marination, 3) interventions such as acid drips, 4) lethality treatments, and 5) drying. The jerky process must eliminate potential hazards due to microbial contamination. The main pathogens of concern are *Salmonella* spp., *Listeria monocytogenes*, *Staphylococcus aureus*, and *Escherichia coli*. *Listeria* is of particular concern because of recent outbreaks from contaminated jerky. The primary control points for eliminating microbial hazards are during the lethality and drying steps. The lethality step destroys any existing pathogens and the drying step reduces the water activity of the jerky below the critical shelf stable value of 0.85.

The Role of Water Activity

Water activity is a measure of the energy status of water in a system and predicts which microorganisms will grow in a food. Microorganisms require water of a specific energy level to grow and survive. Microorganisms do not require a specific amount of water to grow (moisture content), which is why water activity and not moisture content is used as a control point to prevent spoilage. The ancient practice of drying foods is based on reducing water activity through dehydration to prevent spoilage by microorganisms. The U.S. Code of Federal Regulations, in the definition of Non-Potentially Hazardous Food, has established a water activity of 0.85 as the critical value for shelf stability. Products with water activities = 0.85 are considered shelf stable and do not need to be refrigerated. At water activity values of 0.85, none of the potentially hazardous pathogens listed in Table 1 can grow and the only remaining microbial issue is molds, which can be controlled with preservatives or packaging (Table 1).

Table 1. Meat and poultry pathogens of concern and their water activity growth limits.

Microorganism	Water Activity Growth Limit Value
Escherichia coli	0.95
Salmonella spp.	0.95
Listeria monoctyogenes	0.92
Stahphylococcus aureus	0.86

Food Safety and Inspection Service

The USDA Food Safety and Inspection Service (FSIS) has outlined their requirements for jerky safety in "Compliance Guideline for Meat and Poultry Jerky." This directive states that jerky producers should not use moisture protein ratio (MPR) as a measure of proper drying for shelf stability and safety since the water activity can vary greatly at any given MPR, due to different amounts of solutes such as sugar and salt. Therefore, the product water activity is better correlated to inhibition of pathogen growth. The directive also outlines the importance of maintaining high humidity values during the lethality step to prevent pathogens from becoming heat resistant and surviving the kill step. In addition, FSIS Directive 10,240.4 "Verification Procedures for the *Listeria*

monocytogenes Regulation and Microbial Sampling of Ready-to-Eat Products for the FSIS Verification Testing Program" states that *L. monocytogenes* is a hazard and that anyone producing ready-to-eat meats must develop either a Hazard Analysis and Critical Control Point (HACCP) plan or a sanitation Standard Operating Procedure (SOP) to verify that they are controlling the growth of *L. monocytogenes*. Thankfully, a jerky producer can use one HACCP plan to control all pathogenic bacteria including *L. monocytogenes*.

Generic HACCP Model 10

In 1996, the USDA introduced HACCP programs to reduce contamination in foods by hazardous pathogens. In the HACCP program, food production companies create a plan that identifies critical control points in their processing that will prevent or eliminate contamination by hazardous pathogens. In July of 1996, FSIS published a final rule that mandates that HACCP plans be implemented to control contamination of all meat and poultry products. To assist companies in developing their HACCP plans, the FSIS has produced generic HACCP models. In February of 2005, the FSIS released a revised version of its generic HACCP model 10 for Heat Treated-Shelf Stable Meat Products. This generic model identifies water activity as the main post-lethal treatment critical control point, and as the most appropriate way to determine if the jerky product has been properly dried for shelf stability and safety. It also identifies 0.85 as the critical water activity value for shelf stability, and suggests that the instrument being used to measure the water activity of meat products should have an accuracy of +/- 0.003 water activity.

Summary

Water activity is a critical component of jerky safety and shelf stability as outlined by the FSIS. Decagon Devices manufactures water activity instruments that meet the requirements of HACCP model 10. In addition, Decagon can assist jerky producers in monitoring humidity conditions inside their ovens during the heating process. Decagon Devices' applications engineers are ready to help jerky producers monitor their jerky safety using water activity.

Decagon Devices
2365 NE Hopkins Court
Pullman Washington 99163