Special Report

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JERKY COMPLIANCE GUIDELINES
– COMPLIANCE VS. GUIDANCE –

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On May 27, 2004 the U.S. Department of Agriculture's Food Safety and Inspection Service (FSIS) published *Compliance Guidelines for Meat and Poultry Jerky*. Once again, AAMP was put into a reactive situation to determine the implications and how to fulfill the requirements set forth by the new "guidelines." Numerous efforts were made to get information that will be accepted around the United States and disseminate this information as quickly as possible. This AAMP Special Report was produced to help meat processors understand and comply with the USDA requirements.

AAMP would like to make it clear that the guidelines that were posted on May 27, 2004 are "**guidelines**." The suggested methods of thermal processing are recommendations, not regulatory requirements. On the other hand, if meat processors have stated that Appendix A is being used to validate the cooking process, all of the requirements in Appendix A, including time and temperature of processing and the maintenance of oven humidity must be followed.

Throughout CSO audits it was discovered that manufacturers of jerky may not be adequately accounting for the proper lethality of the jerky product, accomplished by heating, prior to the onset of drying. Furthermore, numerous jerky producers were using the jerky moisture protein ratio (MPR) published in USDA's Food Standards and Labeling Policy Book as a Critical Control Point (CCP) in the HACCP plan. The published MPR standards are for labeling purpose only! A MPR of 0.75:1 or less is not correlated to the shelf stability or food safety of the jerky. The MPR that is referred to is related to product characteristic that is expected by the consumers. Therefore, now FSIS wants jerky producers to meet a suggested water activity (a_w).

A meat product with a water activity of less than 0.85 is usually considered shelf stable and would not support the growth of pathogenic microorganisms. A water activity of $\leq$ 0.85 has been common for the control of *Staphylococcus aureus.* It has been well documented that all other pathogens that the meat industry is concerned with have a water activity requirement greater than 0.85 to survive and grow. The U.S. Food and Drug Administration (FDA) published the American national standard for non-potentially hazardous foods in which they define a "non-potentially hazardous food product shall have a water activity of 0.85 or less." Table 1 describes the characteristics of biological hazards that concern meat processors.

Table 1. Biological hazards and controls.

Microbiological Hazard	Minimum a_w	Temperature (°C / °F) (log_{10} reduction)	Minimum pH
Campylobacter	N/A	71.2 °C / 160 °F (meat) [1] 82.3 °C / 180 °F (poultry) [1]	< 4.0 [2]
Clostridium perfringens	< 0.93 [3]	> 60 °C / 140 °F [4]	< 5.0 [3]
E. coli O157:H7	< 0.95 [4]	70 °C / 158 °F (for 2 minutes) [4]	<4.4 (O157:H7 is reported to be acid resistant surviving at pH values below 4.4) [4]
Listeria monocytogenes	< 0.92 [5]	70 °C / 158 °F (for 2 minutes) [5] (10^7 log reduction)	< 4.39 [5]
Salmonella	< 0.94 [6]	70 °C / 158 °F (instant) [7] (10^7 log reduction)	3.8 (most serotypes will not grow below 4.5) [6]
Staphylococcus aureus	< 0.85 [2]	> 60 °C / 140 °F [2]	< 4.0 [2]

1 USDA / FSIS. 1997. Backgrounder – November, 1997. *Campylobacter*: Questions and Answers. www.fsis.usda.gov/OA/background/campy-qa.htm

2 Stevenson, K.E. and Bernard, D.T. 1999. HACCP: A Systematic Approach to Food Safety. Chapter 5: Biological hazards and controls.

3 Jay, J.M. 2000. Modern Food Microbiology.

4 Bell, C. and Kyriakides, A. 1998. *E. coli*: A practical approach to the organism and its control. Chapter 3: Factors affecting growth and survival of *E. coli*.

5 Bell, C. and Kyriakides, A. 1998. *Listeria*: A practical approach to the organism and its control. Chapter 3: Factors affecting growth and survival of *Listeria monocytogenes*.

6 Bell, C. and Kyriakides, A. 2002. *Salmonella*: A practical approach to the organism and its control. Chapter 3: Factors affecting growth and survival of *Salmonella*.

7 USDA / FSIS. 1999. Appendix A – June, 1999. Appendix A: Compliance guidelines for meeting lethality performance standards for certain meat and poultry products. www.fsis.usda.gov/OA/fr/95033F-a.htm

The jerky compliance guidelines suggest a water activity critical limit for stabilization of jerky is $\leq$ 0.70 for product in contact with air, which is low enough to exclude mold growth. If a water activity of 0.85 or below is established as a CCP, the meat processor must add additional control measures. A control measure may be as simple as a vacuum package to exclude the oxygen from the package, thus mold growth would not be a factor since mold requires oxygen to grow. If a pillow pouch package is used, other gases (i.e. nitrogen) must be used to ensure that oxygen is not present in the package. An establishment may want to get a letter of guarantee for their own records from the company supplying the nitrogen gas. If some oxygen is in the package, it is suggested that oxygen scavenger packets are used to remove any possible oxygen. The manufactures of the oxygen scavenger packets should supply you with specification information to document that oxygen scavenger packets remove the oxygen. The application of potassium sorbate on the surface of finished jerky products will also exclude mold growth. The recommended level is 3 oz. of potassium sorbate to 1 gallon of water and applied with a food grade spray bottle.

In the event an establishment uses Appendix A as supporting documentation, all the conditions of Appendix A (i.e., time, temperature, and humidity) must be addressed. Within Appendix A certain criteria are listed to allow establishments to continue producing jerky while complying with Appendix A.

1. Close the oven dampers to provide a closed system and prevent moisture loss. This would meet the requirements of Appendix A provided that the oven remains sealed for 50% of the cooking time and no less than 1 hour; **or**

2. Continuously introducing steam for 50% of the cooking time, but in no case less than 1 hour; **or**

3. If the relative humidity of the oven is maintained at 90% or above for at least 25 percent of the total cooking time, but in no case less than 1 hour.

Other methods have been published by FSIS, but may not be adequate to produce jerky with the same finished product characteristics that is expected of an establishment's specific jerky. The methods and an explanation of why these methods may not be satisfactory are listed below:

1. Preheat the jerky to 160°F (71°C) in the marinade or other solutions, such as water, before racking in the oven to provide an immediate reduction of greater the 5-$\log_{10}$ of *Salmonella* and *E. coli* O157:H7. The times and temperatures in Appendix A could also be used for preheating.

   Explanation: A majority of jerky is manufactured from bottom round and top round (due to leanness) and these particular cuts have a high concentration of connective tissue. When these products are heated in a solution the finished product has a tendency to curl. Therefore it will be difficult to produce a flat jerky when this cooking method is applied.

2. Heat the dried product in a 275°F oven for 10 minutes. This has the potential to further reduce *Salmonella* levels by approximately 2 logs from the level of reduction achieved during initial heat step.

   Explanation: A majority of jerky processors may not have a thermal processing oven that has the capabilities of achieving a dry bulb temperature of 275°F. Furthermore, such an extreme temperature may change the final product characteristics. The final product may be much drier than preferred by consumers in certain regions of the United States.

The following method may be questioned by an inspector or USDA authority for its validity, but was published by the USDA/FSIS.

1. Place a shallow and wide pan of hot water in the oven to provide humidity in the system. A dry run to determine if the water evaporated should be performed. If no evaporation occurred, this would indicate that a relatively high humidity was not maintained in the oven. Use of a wet bulb thermometer in addition to the dry bulb thermometer also would enable the operator to determine if adequate humidity is being applied.

   Explanation: Take for example this scenario…if an establishment was to place a shallow and wide pan of hot water in the smokehouse at the beginning of the thermal processing cycle and it weighed 10 pounds. After the thermal processing cycle, if the pan of water weighed less than 10 pounds, this would demonstrate that the water evaporated into the air causing an increase in humidity. It could be argued that humidity was continual introduced for 50% of the cooking time, but in no case less than 1 hour; which complies with one of the stipulations in Appendix A.

Establishments will have to reassess their jerky thermal processing schedules to ensure that compliance with Appendix A has been achieved. Slight changes in thermal processing schedules may need to be done, but hopefully these changes will not alter the finished product characteristics that each establishment wants to achieve. We recommend that each establishment take the time to write down each step in the jerky thermal processing schedule. This may be considered a Standard Operating Procedure (SOP) for an establishment's thermal processing of jerky. Be sure to record the following:

1. Step number (i.e. 1, 2, 3, etc.)

2. Purpose of each step (i.e. reddening, surface preparation for smoking, smoking, cooking/lethality, drying, etc.)
3. The time for each step
4. Dry bulb temperature (°F)
   Dry-bulb temperature refers basically to the ambient air temperature. The dry-bulb temperature is the temperature of the oven air when measured with a clean, dry temperature sensor.
5. Wet bulb temperature (°F)
   The wet bulb temperature relates relative humidity to the ambient air or dry bulb temperature. The wet-bulb temperature in an oven is measured by fitting a wet, moisture-wicking cloth over an ordinary dry-bulb sensor and placing it in the oven.
6. Relative humidity (%)
   The difference between the dry- and wet-bulb temperatures is used to determine the relative humidity of the oven air. Relative humidity can be determined by a mathematical equation or by a slide rule as long as the dry bulb and wet bulb temperatures are known.
7. Dampers setting (i.e. open or closed)
8. Smoke (i.e. on or off)

With the help from numerous members around the United States, AAMP has complied a few sample smokehouse schedules to help it members comply with Appendix A. Establishments will probably have to make adjustments to make the smokehouse schedule fit appropriately with the available equipment and the desired finished product characteristics. Schedules are separated by the requirements that it applies to in Appendix A.

Appendix A Requirement: Close the oven dampers to provide a closed system and prevent moisture loss. This would meet the requirements of Appendix A provided that the oven remains sealed for 50% of the cooking time and no less than 1 hour.

Step	*Type*	*Time*	*Dry bulb (°F)*	*Wet bulb (°F)*	*% Humidity*	*Dampers*	*Smoke*
1	Surface Preparation	00:20	129	0	0%	open	off
2	Smoke	01:30	125	0	0%	closed	on
3	Smoke/Cook	01:00	155	0	0%	closed	on
4	Cook	01:30	150	0	0%	open	off
5	Dry	00:20	180	0	0%	open	off

This establishment is has a sealed oven for 54% of the total thermal processing cycle, which is in accordance with the requirements in Appendix A

Appendix A Requirement: Continuously introducing steam for 50% of the cooking time, but in no case less than 1 hour.

Step	*Type*	*Time*	*Dry bulb (°F)*	*Wet bulb (°F)*	*% Humidity*	*Dampers*	*Smoke*
1	Surface Preparation	01:00	110	0	0%	open	off
2	Smoke	01:00	130	110	52%	closed	on
3	Smoke	01:00	140	100	27%	closed	on
4	Smoke/Cook	01:00	150	115	34%	closed	on
5	Cook	01:00	160	110	22%	open	off
6	Dry	01:00	175	0	0%	open	off

This establishment is applying humidity for 67% of the total thermal processing cycle, which is in accordance with the requirements in Appendix A

Step	*Type*	*Time*	*Dry bulb (°F)*	*Wet bulb (°F)*	*% Humidity*	*Dampers*	*Smoke*
1	Reddening	00:30	120	0	0%	open	off
2	Surface Preparation	00:30	140	0	0%	open	off
3	Cook	00:20	160	156	90%	open	off
4	Smoke	00:30	130	25	0%	open	on
5	Smoke/Cook	01:30	135	50	2%	open	on
6	Smoke/Cook	00:45	145	120	47%	open	on
7	Dry	00:30	155	125	42%	closed	off

This establishment is applying humidity for 78% of the total thermal processing cycle, which is in accordance with the requirements in Appendix A

Step	*Type*	*Time*	*Dry bulb (°F)*	*Wet bulb (°F)*	*% Humidity*	*Dampers*	*Smoke*
1	Surface Preparation	00:30	129	0	0%	open	off
3	Smoke	01:30	129	122	80%	closed	on
4	Set color	00:15	135	0	0%	open	off
5	Cook	00:30	150	146	90%	open	off
6	Cook	00:30	155	124	40%	open	off
5	Dry	00:30	165	133	40%	open	off

This establishment is applying humidity for 80% of the total thermal processing cycle, which is in accordance with the requirements in Appendix A

A majority of the comments received by AAMP note that it is possible to produce jerky while complying with the Appendix A guidelines. It is recommended that an establishment should experiment with small batches of jerky to determine the best thermal processing method that accommodate their specific requirements, prior to making large batches of products.

It is also recommended that jerky processors monitor the water activity of the jerky rather frequently if water activity has never been monitored in the past. This will help you establish a historical record of your product, which is unique to your establishment and region in the country. Monitor the water activity of the jerky throughout the year to account for any seasonal changes that may affect the thermal processing of the jerky product. As a portion of a water activity-monitoring program, it is beneficial to attach your jerky schedule to your water activity lab results as well as the shrink/yield results for that specific batch. By doing this, an establishment may be able to correlate yield results to water activity. This is very establishment specific, so it must be accomplished at each individual establishment. Over time after an establishment has built up a significant historical record, the establishment may choose to monitor yields and use random testing of water activity as a method to verify that the process is still achieving regulatory requirements.

It is also important to note that FSIS regulations 9 CFR 417.5 require that the establishment maintain all supporting data used to support decisions in their hazard analysis, including decision-making documents associated with the selection and development of CCPs and critical limits. Therefore, if an establishment has a validated study of their own product to ensure the food safety of jerky products being produced, then the establishment's production methods may not come into question by USDA. Unfortunately this is a costly venture to achieve and is usually accomplished at universities. It is our understanding that universities are pursuing funding opportunities from USDA to identify, develop, and validate new technologies that are economically viable for small and very small establishments.

Due to the costs, if an establishment is contemplating the idea of validating their process, it is strongly recommended that the establishment work with USDA or state inspection officials to make sure that the validation study will be accepted in its entirety and achieve the establishment's goal of complying with USDA regulations.

For more information and to keep up to date with any new information regarding jerky production, please visit www.aamp.com.

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