Curing Overview

Meat preservation basics

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Retail Food Safety

agriculture.sc.gov/retail-food-safety

Who is preserving meats?

- High-end restaurants
- Some ethnic restaurants
- Some country stores or meat markets

Potential Hazards

Biological:

- *Salmonella, E. coli/STECs, Listeria, C. botulinum, Staph. aureus*
- Parasites: *Trichinella* (pork); various (fish)
- Viruses: Norovirus, Hepatitis A (human-transmitted; no-cook processes

Chemical:

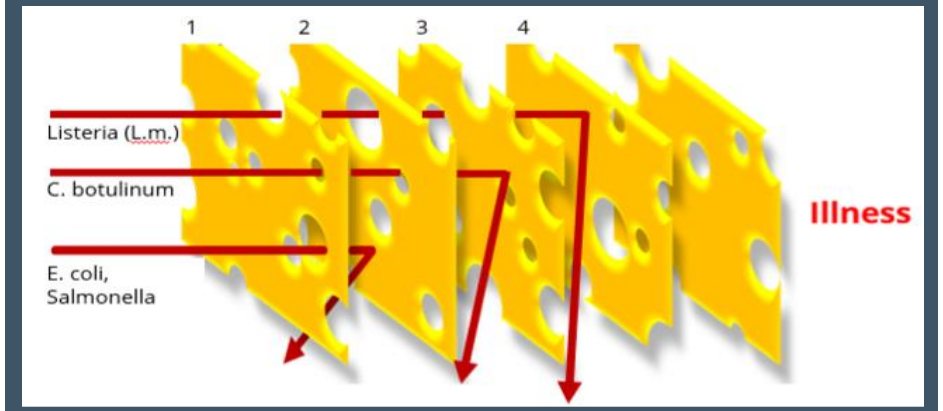
- Nitrite/nitrate, if excess quantity
- Other restricted ingredients?
- Other?

Physical:

- Metal fragments?
- Bone fragments?
- Other?

Common Hurdles in Meat Preservation

Hurdle	Kill Step?	Require CCP?	Other hurdles required?	Effectiveness vs. pathogens
Nitrite/Nitrate	No	Yes	Yes	C. Botulinum only
Reduced pH	No	Yes	Yes	Limits growth
Reduced Aw	No	Yes	Yes	<0.85 stops growth
Salt, sugar	No	Depends	Yes	Salt tolerance varies
Fermentation	No	Yes	Yes	Limits growth
Cooking	Yes *	Yes	Yes	Destroys veg. cells



Common Curing Steps

Curing Process	Products
Drying / dehydration	Dry/semi-dry sausages, jerky, hams
Application of cure agent	
• Comminuted	Sausages, snack sticks
• Dry rubbed	Prosciutto, bacon, pastrami, pancetta, coppa, bresaola, etc.
• “Pickling” (immersion)	Hams, pastrami
• Pumping / injecting	Hams
Fermenting / acidification	Salami (sopressata, Genoa, pepperoni), biltong
Cooking / smoking	Sausages, hams, jerky

Critical Limits: Dehydration / Drying

Drying / dehydration

- *Jerky, snack sticks: Aw <0.85*
- *Dry sausages: Aw ≤0.90, pH ≤5.0 (Table B, non-TCS)*
- *Semi-dry sausages: Aw >0.90, pH ≤5.0 (Table B, TCS)*
- *Country (Virginia) hams* : aged 45 to 180 days at 75 to 95°F with relative humidity 55 to 65% and air circulation; must lose 8-12% of green weight*

Monitoring drying:

- *Net weight loss*
- *Final water activity*

Critical Limits: Applying Cure

Application of cure mixture

- *Ingoing* concentration
- Exposure time!
- Nitrite/Nitrate – restricted!
  - Meats: 9 CFR 424.21
  - Fish: 21 CFR 172.175 / 172.177
  - Salmon, Shad, Sable Fish and Chubs: 200 ppm limit
  - Tuna: 10 ppm
- Consistent size and thickness

Monitoring curing: Accurate weighing; time

Use of "Cure #1" in cured meat or poultry products					
Cure #1 6.25% Sodium Nitrite and 93.75% Sodium Chloride (Salt)					
	Comminuted	Immersion	Dry Rub	Bacon Immersion	Bacon Dry Rub
[1]USDA critical limit -	≤156 ppm	≤200 ppm	≤625 ppm	≤120 ppm	≤200 ppm

[1] *The regulatory critical limit for nitrite is published in 9 CFR Part 424. Always follow manufacturer instructions for use of cure salt, as formulation differences may result in variation in the weight percent of nitrite between different products. USDA FSIS recommends using these specified amounts - not more, not less.*

Critical Limits: Fermentation

Fermentation

- *pH drop <5.3* within allowed time
- Typical drop is to pH ~4.5-4.7
- Other controls include:
  - Low air flow
  - 65% to 75% relative humidity
  - Without high humidity step, product surface dries too quickly, and surface pathogens can persist.

Monitoring fermentation: pH, temperature, time

The time-temperature relationships for constant temperature processes are as follows:

Degree-Hours Above 60°F	Chamber Temperature (°F)	Maximum Hours to pH 5.3
1200	75	80
1200	80	60
1200	85	48
1000	90	33
1000	95	28
1000	100	25
900	105	20
900	110	18

Critical Limits: Fermentation

Smoking or cooking

Internal temperatures (*examples*)

- **Whole muscle beef, pork jerky*** : ≥145°F + continuous steam ≥ 1 hr (option 1)

  or ≥145°F + 50% humidity ≥ 1 hr, sealed oven (option 2)

  or ≥145°F (or any Appendix A temp/time combo) with humidity ≥90% for at least 25% of cooking time but no less than 1 hour. (Options 3 and 4)

- **Beef, pork snack sticks**: ≥155°F; time and humidity options same as for jerky
- **Cooked sausages**: ≥155°F for at least 17 seconds
- **Whole muscle beef & pork roasts** (hams, brisket, bacon): ≥145°F for at least 15 seconds
- Without high humidity step, product surface dries too quickly, and surface pathogens can persist.

Calculations - Notes

Using the Cure Calculation Spreadsheet:

1. Recipe amounts in weight units
2. Convert to metric units (g or Kg) helpful
3. Use correct sheet based on cure #1 or cure #2
4. Slow cures with cure #2 require cure accelerator
5. Cure #2 not allowed for bacon
6. Cure #2 calculation yields total ingoing nitrite

Essential conversion factors:

2.20 lb = 1 L

1.0 lb = 453.54 g

1 oz = 28.3 g

1 gal = 3780 g (*water*)

1 mL = 1.0 g (*water*)

Calculations - Sausage

Pepperoni (one published recipe)

2kg Pork butt (fat included) ✓
1kg Beef chuck (fat included) ✓
80g Prague powder #1 ✓
10ml Sugar = 8.5 g
20ml Cayenne pepper = 90 g
30ml Paprika = 115 g
15ml Aniseed = 2.27 g
5ml Dried garlic granules = 1.4 g
300ml (1.265 cups) Dry red wine = 315 g

Enter % Sodium Nitrite in curing salt used:	6.25 % ✓

grams cure	lbs meat	ppm Nitrite
80	6.6	1670.2

Maximum allowed for this process is 156 ppm.

Calculations – Dry Rub

Pastrami (Dry Cure 7 days under refrigeration)

4.5 lb trimmed beef brisket ✓

¼ cup Morton Tender Quick = 2 oz (56.6 g) ✓
(0.5% sodium nitrite & 0.5% sodium nitrate)

¼ cup dark brown sugar (packed) = 55 g

2 Tbsp dehydrated garlic powder = 19.7 g

2 Tbsp ground coriander = 10.1 g

Total weight of dry rub (use all!) = 141.4 g ✓

Cooking rub: **(not part of calculation!)**

3 Tbsp black peppercorns (freshly ground)

1 tsp ground coriander seeds

1 tsp dehydrated garlic powder

Calculate ingoing nitrite from dry rub mixture (convert all weights to Lbs)

Total weight of all ingredients except cure salt may be entered below the cure salt line, instead of listing weights of individual ingredients

Convert grams to pounds				Calculate Lbs of cure mix	
56.6	grams	0.1248	lbs	0.1248	cure salt
141.4	grams	0.3118	lbs	0.3118	
	grams	0.0000	lbs	0.0000	
	grams	0.0000	lbs	0.0000	
	grams	0.0000	lbs	0.0000	
	grams	0.0000	lbs	0.0000	
	grams	0.0000	lbs	0.0000	
				0.44	Tot. Lbs Cure Mix Batch
Protein:				0.4400 ✓	Lb cure mix used per recipe
2041	grams	4.5002	lbs		

Total Cure Mix batch weight, lbs	0.44
Lb of cure salt in cure mix recipe	0.1248
lbs dry rub mix used per curing batch	0.4400
Equivalent lb of nitrite in cure mix recipe	0.0011
Lb of meat/protein per curing batch	4.50
Enter % Sodium Nitrite in curing salt used:	0.50 %
Enter % Sodium Nitrate in curing salt used: ✓	0.50 %

	ppm Nitrite
Actual value:	253.20

Maximum allowed for this process is 625 ppm.
NOTE:
9 CFR 424.21, 9 CFR 424.22 prohibit use of nitrate in curing bacon

Calculations – Immerse or Inject

Fresh Ham (immerse 1 day per 2 lbs under refrigeration; depends on roast size!)

7.0 lb pork roast ✓

2.5 Tbsp cure #1 = 72 g ✓
2-1/4 cups kosher salt = 547.5 g
2 cups dark brown sugar (packed) = 440 g
¼ cup molasses = 70 g
1 Tbsp pickling spice = 5.8 g
6 qts water = 5678 g
Total weight of brine (use all!) = 6813.3 g ✓

Enter % Sodium Nitrite in curing salt used: 6.25 % ✓

Calculate % Pickup for Brine Immersion Method						Injection Curing	
Brine Batch Produced			Brine Batch Used			Complete the g of cure and batch wt, g fields at left	
g of cure	72.00	grams	Initial Brine wt used, lb	1.40			
batch wt, g	6813.30	grams	Initial protein wt, lb	7.00		g of brine injected	
lb of cure	0.16	lbs	final protein wt, lb	8.40		lb of meat cured	
batch wt, lb	15.02	lbs	lb cure in brine used	0.015		lb of cure injected	0

Ingoing Lb of Cure	Lb. Brine Batch USED	%Pickup
0.01	1.40	0.20

	ppm Nitrite
Actual value:	132.09

Maximum allowed for this process is 200 ppm.

AFDO Resources

Guidance for Developing HACCP Plans for Specialized Processes at Retail

HACCP Plan templates for Specialized Processes

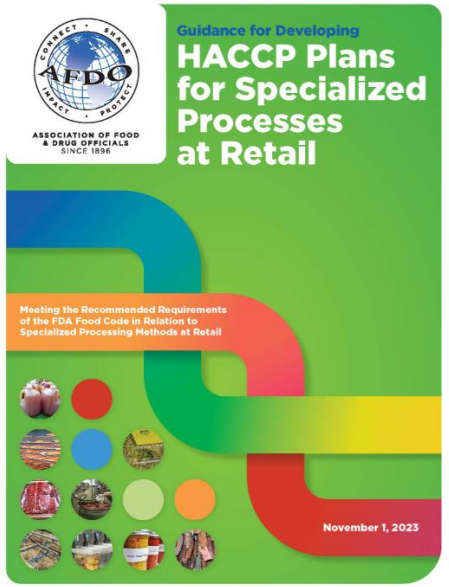
Curing Recipe Template

Curing Calculation Spreadsheet

HACCP Plan Templates and Examples

By Category | By Document Type

- HACCP Plans
- HACCP Checklists
- Training Supplements
- Curing Recipe
- Curing Calculator



Questions?

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