Further Processing and Labeling - Quick Reference Guide

Sausage Operations

Added Water Regulatory Limits for Raw Sausages

Added Water = 3% of total ingredients (**10%** in finished cooked sausage product, verified by FSIS laboratory analysis)

Added Water Calculation Steps

Step 1: lb. total raw batch weight [100% batch]
- lb. added water [-3% regulatory limit]
lb. formula weight [97% batch weight, less 3% added water]

Step 2: lb. formula wt. ÷ .97 [97% formula] = 100% calculated wt. [97% formula weight with 3% added water]

Step 3: lb. calculated weight [100% calculated weight]
- lb. formula weight [- 97% formula weight]
lb. maximum added water [3% water regulatory limit]

Added Water Calculation Example

An establishment produces a raw beef and pork sausage product. The product formula on file shows a total batch weight of 750 lb., including 21 lb. of added water/ice.

Determine if the amount of added water/ice documented in the product formula on file is in compliance.

Step 1: 750 lb. total raw batch weight [100% batch]
- 21 lb. added water [-3% regulatory limit]
729 lb. formula weight [97% batch weight, less 3% added water]

Step 2: 729 lb. [formula wt.] ÷ .97 [97% formula] = 751.54 lb. calculated wt. [97% formula weight with 3% added water]

Step 3: 751.57 lb. calculated weight
- 729 lb. formula weight
22.54 lb. maximum added water - in compliance

Antioxidant and Synergists in a Compound or Mix

Antioxidants may be permitted in fresh meat and poultry products to inhibit oxidative rancidity and protect flavor. Antioxidant limits are based on the product's ***fat content at the time of formulation.*** Many establishments will include a ***target fat content*** in the product recipe on file. The target fat content can be used in antioxidant calculations to determine if the documented product formulation is in compliance with regulatory limits. If the fat percentage cannot be

determined from the meat or poultry ingredients added to the product formulation or the establishment does not provide a target fat content, the product's official fat analysis result with the lowest percent fat content can be used in antioxidant verification calculations.

Synergists are chemicals often used in combination with antioxidants to help the antioxidant work better, however, synergists are not antioxidants. When synergists are included in a formula, the synergist amount is also considered in the process of determining the amount of antioxidants that are permitted.

In accordance with 9 CFR 424.21(c), antioxidants permitted in fresh sausage products are limited to 0.01% singly or 0.02% in combination. One calculation is sufficient for calculating regulatory limits for antioxidants and synergists in a mixture if the following rules are used:

(1) If ***no*** *individual antioxidant or synergist* in the mix is *50% or more* of the ***total amount of antioxidants***, calculate for the total of ***all*** *antioxidants* using the .**02%** limit.

(2) If ***one*** *individual antioxidant or synergist* in the mix is *50% or more* of the **total amount of antioxidants**, calculate for **that individual** *antioxidant or synergist* using the .**01%** limit.

The following calculation examples are used to verify how much antioxidant/synergist mix is permitted in the formulation for various fresh sausage products made with pork when:

(A) No individual antioxidant or synergist is 50% or more of the total amount of antioxidants.
(B) One individual antioxidant is 50% or more of the total amount of antioxidants.
(C) One individual synergist is 50% or more of the total amount of antioxidants.

Answer the questions in each of the following examples.

Example A: ***No*** *individual antioxidant or synergist* in the mix is *50% or more* of the *total amount of antioxidants* - calculate for the total of ***all antioxidants*** using the .**02%** limit.

An establishment produces a fresh breakfast sausage (9CFR 319.143) product that contains pork, beef, pork and beef byproducts, mechanically separated species, and non-meat ingredients. The product formulation on file documents that each 1150 lb. batch has a target fat content of 460 lb. Non-meat ingredients include a 6 ounce antioxidant/synergist mix that contains antioxidants, a synergist, and carrier.

NOTE*: The percentage of fat can be determined if the product's target fat content or actual added fat weight is known by dividing the target or total fat weight by the batch weight, then multiplying by 100:*

(460 lb. ÷ 1150 lb.) x 100 = ***40% target fat content***

A.1) What is the total amount of antioxidant mix permitted in the fresh breakfast sausage product? **7.36 oz. maximum antioxidant mix permitted**

A.2) Is the antioxidant mix in this product in compliance? **Yes, 6 oz. of mix was used and up to 7.36 oz. of antioxidant mix is permitted.**

Further Processing and Labeling - Quick Reference Guide

Step 1: Determine the pounds of fat on which the antioxidant amount is based.

460 lb. target fat content *(from the formula on file)*

Step 2: Determine the total content of the antioxidant/synergist mix and the percentage of each ingredient. Ingredients and their percentages are usually listed on the antioxidant/ synergist mixture container label.

Antioxidant mix ingredients and percentages given on Product A's antioxidant mix package label:

10% BHT - antioxidant
10% BHA - antioxidant
10% Propyl gallate - antioxidant
5% Monoglyceride citrate - synergist
65% Carrier
100% antioxidant/synergist mix

Step 3: Determine what percentage of this mixture is made up of antioxidants.

10% BHT + 10% BHA + 10% propyl gallate = **30% total antioxidants**

Step 4: Determine what percentage is 50% (half) of the antioxidant total.

30% ÷ 2 = **15% half (or 50%) of total antioxidants**

Step 5: Determine if one antioxidant or synergist in the antioxidant/synergist mix makes up 50% or more of the antioxidant total from the mix

No individual antioxidant (10% BHT, 10% BHA, 10% propyl gallate) or synergist (5% monoglyceride citrate) is 50% or more of the total antioxidants (15%) in the mix.

Step 6: Since no single antioxidant or synergist makes up 50% or more of the antioxidant total, multiply the fat content weight by .0002 (.02%) to determine the total amount antioxidants allowed.

460 lb. x .0002 = **0.092 lb. antioxidant regulatory limit**

Step 7: Divide the amount of antioxidants allowed by the percent of total antioxidants in the mix, then multiply by 16 to determine the ounces of antioxidant mixture permitted in this product.

0.092 lb. ÷ .20 = 0.46 lb. x 16 = **7.36 oz. maximum antioxidant mix permitted**

Example B: ***One individual*** *antioxidant or synergist* in the mix is *50% or more* of the *total amount of antioxidants* - calculate for **that individual *antioxidant or synergist*** using the .**01%** limit.

An establishment produces a fresh pork sausage (9CFR 319.141) product that contains pork trimmings, water, spices, and a seasoning mix that contains 2 ounces of an antioxidant mix

that contains antioxidants, a synergist, and carrier. The product formulation on file documents a 40% target fat content and the following ingredients:

Pork trimmings	1050 lb.
Water	32 lb.
Spices	10 lb.
Seasoning mix	8 lb.
Total	1100 lb. (40% target fat content)

B.1) What is the total amount of antioxidant mix permitted in the fresh pork sausage product? **2.81 oz. maximum antioxidant mix permitted**

B.2) Is the antioxidant mix in this product in compliance? **Yes, 2 oz. of mix was used and up to 2.81 oz. of antioxidant/synergist mix is permitted.**

Step 1: Determine the pounds of fat for which the antioxidant amount is to be based on.

1100 lb. x .40 = **440 lbs. target fat**

Step 2: Determine the total content of the antioxidant/synergist mix and the percentage of each ingredient. Ingredients and their percentages are usually listed on the antioxidant mixture container label.

Antioxidant mix ingredients and percentages given on the Product B seasoning mix package label:

BHA 25% - antioxidant
BHT 8% - antioxidant
Glycine 8% - antioxidant
Propyl gallate 7% - antioxidant
Citric acid 10% - synergist
Carrier 42%

100% antioxidant/synergist mix

Step 3: Determine what percentage of this mixture is made up of antioxidants.

25% BHA
8% BHT
8% Glycine
7% Propyl gallate
48% total antioxidants

Step 4: Determine what percentage is 50% (half) of the antioxidant total.

48% ÷ 2 = **24% half of total antioxidants**

Step 5: Determine if one antioxidant or synergist in the antioxidant/synergist mix is 50% or more of the antioxidant total from the mix.

BHA (25%) is 50% or more of total antioxidants (24%) in the mix.

Step 6: Since BHA makes up 50% or more of the antioxidant total, multiply the fat content weight by .0001 (.01%) to determine the amount of BHA allowed.

440 lb. x .0001 = **0.044 lb. antioxidant regulatory limit**

Step 7: Divide the amount of antioxidant permitted by the percent of the major antioxidant or synergist in the mix to determine the amount of antioxidant/synergist mixture that can be used.

***NOTE**: since the BHA antioxidant makes up more than 50% of the antioxidant total, we will divide the maximum amount of antioxidant permitted by the percentage of the BHA in the antioxidant/synergist mix.*

0.044 lb. ÷ .25 = 0.176 lb. x 16 = **2.81 oz. maximum antioxidant mix permitted**

Example C: ***One** individual antioxidant or synergist* in the mix is *50% or more* of the **total amount of antioxidants** - calculate for **that individual** *antioxidant or synergist* using the .**01%** limit.

An establishment produces a fresh whole hog sausage (9CFR 319.144) product that contains pork, pork trimmings, water, spices, and a seasoning mix that contains 4 ounces of antioxidants, a synergist, and carrier. The product formulation on file documents the following ingredients:

Pork	750 lb.	(fat content 30%)
Pork trimmings	425 lb.	(fat content 85%)
Water	34 lb.	
Spices	9 lb.	
Seasoning mix	7 lb.	
Total	1225 lb.	

C.1) What is the total amount of antioxidant mix permitted in the fresh whole hog sausage product? **3.12 oz. antioxidant mix permitted**

C.2) Is the antioxidant mix in this product in compliance? **No, up to 3.12 oz. antioxidant mix is permitted but 4 oz. was used.**

Step 1: Determine the pounds of fat for which the antioxidant amount is to be based on.

750 lb. x .30 = 225 lb. fat
425 lb. x .85 = 361.25 lb. fat

225 lb. + 361.25 lb. = **586.25 lb. total fat content**

Step 2: Determine the total content of the antioxidant/synergist mixture and the percentage of each ingredient. (Ingredients and their percentages are usually listed on the antioxidant container label.)

Antioxidant mix ingredients and percentages given on the Product C seasoning mix package label:

10% BHA - antioxidant
8% BHT - antioxidant
7% TBHQ - antioxidant
5% Propyl gallate - antioxidant
30% Citric acid – synergist
40% Carrier
100% antioxidant/synergist mix

Step 3: Determine what percentage of this mixture is made up of antioxidants.

Antioxidants: 10% - BHA
8% - BHT
7% - TBHQ
5% - Propyl gallate
30% - Total antioxidants

Step 4: Determine what percentage is 50% (half_ of the antioxidant total.

30% ÷ 2 = **15% half of total antioxidants**

Step 5: Determine if one antioxidant or synergist in the antioxidant/synergist mix is 50% or more of the antioxidant total from the mix.

Citric acid (30%) is 50% or more of total antioxidants (15%) in the mix.

Step 6: Multiply the weight of the added fat by.0001 (.01%) to determine the maximum amount of antioxidant/synergist permitted.

586.25 lb. x .0001 = **0.0586 lb**.

Step 7: Divide the amount of antioxidant permitted by the percent of the major antioxidant or synergist in the mix to determine the amount of antioxidant/synergist mixture that can be used. Since the citric acid synergist makes up more than 50% of the antioxidant total, divide the maximum amount of synergist permitted by the percentage of the citric acid in the antioxidant/synergist mix.

0.0586 lb. ÷ .30 = **0.195 lb. antioxidant regulatory limit**

Step 8: Multiply the amount of antioxidant/synergist mixture permitted by 16 to determine the maximum ounces of antioxidant/synergist mixture allowed in the product formula.

0.195 lb. x 16 = **3.12 oz. antioxidant mix permitted**

Calculating for a Synergist

If a synergist is 50% or more of the total antioxidants in the mix, calculate the antioxidant regulatory limit using the .01% limit for that individual synergist.

Consider a fresh pork sausage product formulation with a total batch weight of 700 lb. Ingredients include 260 lb. of added fat and 2.5 oz. of antioxidant mix that contains:

- 10% BHT (antioxidant);
- 10% BHA (antioxidant);
- 5% propyl gallate (antioxidant);
- 15% citric acid (synergist);
- 60% salt (carrier).

The amount of antioxidants in this formulation totals 25% of the antioxidant mix (10% BHT + 10% BHA + 5% propyl gallate = 25%).

Calculating for 50% of the total antioxidants in the mix, 25% ÷ 2 = 12.5% (or 25% x 0.5 = 12.5%).

In this mix, none of the individual antioxidants are more than 12.5%, but the synergist is greater at 15%. Therefore, to determine the maximum amount of antioxidant mix permitted in the formula, calculate the amount of the synergist permitted in the formula using the .01% limit.

260 lb. fat x 0.0001 = 0.026 lb. maximum of either individual BHA or BHT antioxidants permitted in the antioxidant mix.

0.026 lb. ÷ 0.15 (percent of synergist) = 0.17 lb. maximum amount of antioxidant mix permitted.

0.17 lb. x 16 (oz./lb.) = **2.72 oz. antioxidant mix permitted**. The 2.5 oz. of antioxidant mix used in the formula is in compliance with the maximum amount of 2.72 oz. mix permitted.

Calculating Exactly 50% Antioxidants

Directive 7620.3, *Processing Inspectors' Calculations Handbook*, states:

"When antioxidants are part of a mixture, it is not necessary to calculate for each one. One calculation will be sufficient if the following rules are followed:
(1) If no individual antioxidant or synergist is 50% or more of the total antioxidants in the mix, calculate for the total of all antioxidants using the .02% limit.
(2) If one individual antioxidant or synergist is 50% or more of the total antioxidants in the mix, calculate for that individual antioxidant or synergist using the .01% limit.

When two individual antioxidants in an antioxidant mix equal exactly 50% of the total antioxidants in that mix, either rule may be used. Following these rules, the antioxidant regulatory limit can be determined by:

1) Multiplying the amount of fat by .02% (0.002) to solve for the total amount of *all antioxidants* in the mix.
2) Multiplying the amount of fat by .01% (0.001) to solve for the individual *antioxidant or synergist* that equals 50% of the antioxidant total in the mix.

50% Antioxidants Calculations

Consider a fresh breakfast sausage product formulation with a total batch weight of 650 lb. Ingredients include 250 lb. of added fat and 2.4 oz. of an antioxidant mix that contains:

- 15% BHT (antioxidant);
- 15% BHA (antioxidant);
- 10% citric acid (synergist);
- 60% salt (carrier).

Further Processing and Labeling - Quick Reference Guide

The total amount of antioxidants = 30% of the mix (15% BHT, 15% BHA).

Half (50%) of the total antioxidants = 15% (30% ÷ 2) or (30% x 0.5).

Since both the BHT and BHA each equal 50% of the total antioxidants in the formulation, the maximum amount of antioxidants permitted in the fresh sausage formulation can be determined using either .02% or .01 % as shown in the following calculation examples.

.02% Antioxidant Example

250 lb. fat x 0.0002 = 0.05 lb. max. amount for the total antioxidants in the mix.

0.05 lb. ÷ 0.30 (total % of antioxidants) = 0.16 lb. max. amount of antioxidant mix permitted in the formula.

0.16 x 16 (oz./lb.) = 2.56 oz. maximum amount of antioxidant mix permitted.

.01% Antioxidant Example

250 lb. fat x 0.0001 = 0.025 lb. maximum of either individual BHA or BHT antioxidants permitted in the antioxidant mix.

0.025 lb. ÷ 0.15 (percent of one antioxidant, either BHA or BHT, equal to 50% of the antioxidant total) = 0.16 lb. maximum amount of antioxidant mix permitted.

0.16 lb. x 16 (oz./lb.) = 2.56 oz. antioxidant mix permitted .

The amount of antioxidants in the 2.4 oz. of antioxidant mix used in the formula are in compliance with the maximum amount of 2.56 oz. permitted.

As you can see, using either rule to calculate the antioxidant regulatory limit when two antioxidants equal exactly 50% of the antioxidant total will result in the same answer.

Further Processing and Labeling - Quick Reference Guide

Cured Meat and Poultry Product Operations

Ingoing Curing Agent and Curing Accelerator PPM

$$\text{ppm} = \frac{\text{lb. RI} \times 1{,}000{,}000}{\text{lb. meat block}}$$

RI (Restricted Ingredient) = specific curing agent or curing accelerator
Meat block = meat, meat byproducts, poultry, and/or poultry byproducts

Curing Agent Added to the Formula in a Curing Compound or Mix

$$\text{ppm} = \frac{\text{lb. of cure mix} \times \text{\% of cure agent in mix} \times 1{,}000{,}000}{\text{lb. of meat block}}$$

Maximum Curing Agent or Curing Accelerator Allowed

$$\text{Max. cure agent or (curing accelerator)} = \left(\frac{\text{lb. of meat block}}{100 \text{ lb.}}\right) \times \text{Restricted agent/accelerator level per 100 lb. of meat block}$$

Regulatory Limits

Curing Agents

(1) Nitrite - **.25 oz./100 lb.** of chopped meat, meat byproduct, poultry, and poultry byproduct OR **156 ppm** ingoing
(2) Nitrate - **2.75 oz./ 100 lb.** of chopped meat, meat byproduct, poultry, and poultry byproduct OR **1,718 ppm** ingoing

Cure Accelerators

(1) Ascorbate/Erythorbate - **.875 oz./100 lb.** of chopped meat, meat byproduct, poultry, and poultry byproduct OR **547 ppm** ingoing
(2) Ascorbic acid/ erythorbic acid - **.75 oz/100 lb.** of chopped meat, meat byproduct, poultry, and poultry byproduct OR **469 ppm** ingoing

Regulatory Limits for Additives in Cooked Sausages-Based on the Projected Finished Weight (PFW)

Binders and Extenders: Cereal, NFDM, CRDSM, and many more listed is section 424.21(c) --3.5% maximum individually or collectively

Phosphates - 0.5% (5000 ppm)

Further Processing and Labeling - Quick Reference Guide

PFW Calculation Steps/Ingredient Compliance Determination based on the PFW

Step 1: Remove the weight of water from the formula (batch) weight ***and*** the target % the water represents (10, 12, 15, etc.);

Step 2: Continue by removing the weight of any ingredients with a regulatory limit based on a PFW, (e.g., binders and phosphates) from the remaining formula (batch) weight ***and*** their % regulatory limit from the remaining formula %;

Step 3: Divide the remaining weight of the formula (batch) by the % it represents to determine the PFW; and then

Step 4. Multiply the PFW by the ingredient's % regulatory limit to determine maximum amount of that ingredient allowed in the formula.

Potential Pitfalls: Not removing any rework from formula (batch) weight before starting the PFW calculation and not considering water in corn syrup.

PPM Equation

$$ppm = \frac{\text{lb. RI (Restricted Ingredients)} \times \% \text{ Pump} \times 1{,}000{,}000}{\text{lb. Pickle}}$$

NOTE: *If a curing compound is used, multiple the weight of the compound by the % of nitrite/nitrate in the compound to determine the weight of the nitrite/nitrate (RI).*

Pump, Pick-up, Added Solution or Gain Equation

$$\%\ \text{pump, pick-up, gain} = \frac{\text{pumped wt. - green wt.}}{\text{green wt.}} \times 100$$

Percent Yield Equation

$$\%\ \text{yield} = \frac{\text{finished wt.}}{\text{green wt.}} \times 100$$

Further Processing and Labeling - Quick Reference Guide

Volume of Rectangular Tank Equation

cubic inches = (length in inches) × (width in inches) × (height in inches)

NOTE: *1 gallon = 231 cubic inches*

Maximum Ingoing Nitrite and Nitrate Limits (in PPM) for Meat and Poultry Products*

	Curing Method			
Curing Agent	Immersion Cured	Massaged or Pumped	Comminuted	Dry Cured
Sodium Nitrite	200	200	156	625
Potassium Nitrite	200	200	156	625
Sodium Nitrate	700	700	1718	2187
Potassium Nitrate	700	700	1718	2187

*Except for bacon

Maximum Ingoing Cure Accelerators (in PPM) for Meat and Poultry Products

Cure Accelerator	**Maximum Limit**
Ascorbic Acid	469 ppm*
Erythorbic Acid	469 ppm*
Sodium Ascorbate	547 ppm*
Sodium Erythorbate (isoascorbate)	547 ppm*

*Except in bacon

RI Regulatory Limits for Pumped or Massaged Bacon

Establishment's written procedure:

- Must demonstrate 120 ppm ingoing sodium nitrite or 148 ppm potassium nitrite ***AND***
- Must demonstrate 550 ppm of sodium erythorbate or sodium ascorbate

NOTE: *A plus or minus 20% allowance at the time of injecting or massaging.*

Further Processing and Labeling - Quick Reference Guide

Meat and Poultry Products with Added Solutions

Pump, Pick-up, Added Solution or Gain Equation for RAW Products

$$\% \text{ pump, pick-up, gain} = \frac{\text{pumped (treated) wt. - green wt.}}{\text{green wt.}} \times 100$$

Pump, Pick-up, Added Solution or Gain Equation for COOKED Products

$$\% \text{ pump, pick-up, gain} = \frac{\text{finished wt. - green wt.}}{\text{finished wt.}} \times 100$$