AMERICAN MEAT ASSOCIATION • FACT SHEET

A Comparison Of Traditional And Alternative Meat Curing Methods

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The practice of curing meats for human consumption has been around for thousands of years. The first cured meats are thought to have originated from meats salted using unrefined salt that naturally contained small amounts of nitrate. Cured meats have many specific characteristics and are a result of including of curing ingredients and reactions that create a stable pink cured meat color and unique flavor and aroma associated with cured meat. Furthermore, these curing ingredients provide added antioxidant activity and microbial and pathogen control.

Meat curing ingredients

In order to understand meat curing and the differences in curing methods, one needs to have an understanding of the oxidation reduction reactions that interconnect curing ingredients (Figure 1). Nitrate reduction to nitrite requires specific bacteria that possess nitrate reducing enzymes. Nitrite reduction to nitric oxide occurs during meat curing by interactions with components in the meat and added ingredients. For meat curing to occur, nitric oxide must be produced.

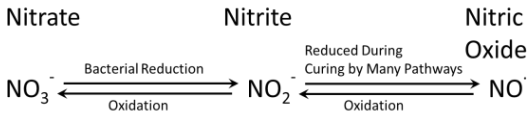

Figure 1. Oxidation reduction relationship of nitrate, nitrite, and nitric oxide.

The United States Department of Agriculture (USDA) defines curing agents as sodium and potassium salts of nitrate and nitrite and usage of these curing ingredients is strictly regulated. Although saltpeter (potassium nitrate) was originally used to cure meat, sodium nitrite is the most common curing ingredient used in modern cured meat production (traditional curing method). The USDA has established regulatory limits for the addition of sodium nitrite at 120 ppm (0.012%) in bacon, 200 ppm (0.02%) for dry cured bacon, up to156 ppm (0.0156%) for products such as frankfurters or cured sausages, up to 200 ppm (0.02%) in brine cured or injected products such as ham or pastrami, and up to 625 ppm (0.0625%) of sodium nitrite in dry-cured meat products. Additionally the USDA requires 550 ppm (0.055%) of sodium ascorbate or sodium erythorbate be added in bacon production which increases nitric oxide formation and greatly reduces or prevents the formation of nitrosamines. Sodium nitrite is often added as a curing salt mixture (sodium chloride and sodium nitrite) to prevent the accidental addition of sodium nitrite above the regulatory limits. One commonly used curing salt contains 6.25% sodium nitrite and 93.75% sodium chloride.

Over the past decade, meat processors have started utilizing alternative methods to cure meat by using ingredients naturally high in nitrate. The most common natural curing ingredient is celery juice powder. By adding an ingredient containing natural nitrate in combination with a nitrate reducing bacterial starter culture, cured meats can be manufactured without the direct addition of purified sodium nitrite. However to use these natural ingredients, an incubation step is needed to reduce nitrate to nitrite. Recently, ingredient suppliers have begun incubating the celery juice with bacterial starter cultures prior to drying which eliminates the need for an incubation step during the cooking process. Typically used

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concentrations of naturally occurring nitrate from celery juice are equivalent to about 1/4 to 1/2 of the regulatory limits for ingoing sodium nitrite *(3, 5)*.

Cured meat characteristics

Cured meats have unique color, flavor, and aroma as well as microbial control and antioxidant activity that are developed by reactions of nitric oxide with meat. Cured meats cannot be produced without the formation of nitric oxide from the added nitrite or nitrate.

Regardless of curing method (traditional or alternative), the resulting products have many similar cured meat characteristics. Pink cured meat color is formed from the reaction of nitric oxide and myoglobin (a meat pigment similar to hemoglobin) during processing and cooking. It is generally recognized that stable cured meat color can be achieved with 40 ppm of sodium nitrite, *(7)* and both curing methods provide sufficient amount of curing ingredients (purified sodium nitrite or natural sources of nitrate or nitrite). Similarly, both traditional and alternative curing methods supply sufficient curing ingredients (50 ppm of sodium nitrite or greater) to produce cured meat flavor and aroma and antioxidant activity *(4)*.

Antimicrobial activity associated with meat curing requires greater amounts of curing ingredients than do cured meat color, flavor and antioxidant activity. As a result, the USDA requires more stringent safe product handling instructions when less than 120 ppm of sodium nitrite is added to cured meats *(7)*. The growth of *Clostridium botulinum*, a neurotoxin producing pathogen, is inhibited by sodium nitrite while *Listeria monocytogenes* growth is delayed in cured meat products.

Some concerns have been expressed regarding the antimicrobial properties of alternatively cured meats due to lower nitrite (or equivalent nitrate) concentrations used during processing. However when the alternative curing methods are coupled with natural antimicrobial compounds or combinations such as vinegar, cherry, and lemon powders, cultured sugar, or post processing pasteurization methods (high pressure processing, thermal processing, etc.), alternatively cured products have been shown to offer similar pathogen control to traditional cured meat products *(1, 3, 5)*.

Not all curing ingredients are converted to nitric oxide and react with the meat during processing and cooking. Low concentrations of nitrite (typically about 5-20% of added nitrite) remain in cured meats regardless of curing method and are important in maintaining cured product color, antioxidant activity and microbial control. The remaining nitrite concentrations are similar between traditional and alternative curing methods *(6)*.

Labeling requirement of traditional and alternative cured meat products

The USDA has defined Standards of Identity for processed meats, and the standard of identity of some products, including frankfurters, ham, and bacon, states that they are cured. The USDA further defines cured meats as those that include the addition of sodium nitrite, sodium nitrate, potassium nitrite or potassium nitrate. If a product defined as cured in its standard of identity is manufactured without one of the USDA recognized curing ingredients, the manufacturer must include "uncured" following the product name and "no nitrate or nitrite added except those naturally found in (added ingredients)" on the product label. Due to this regulation, cured meats produced with an alternative curing methods are required be labeled as "uncured" and "no nitrate or nitrite added" even though they have cured meat characteristics and contain residual nitrite and nitrate that is indistinguishable from those found in traditionally cured products.

Sources of daily consumption of nitrate and nitrite

Daily intake of nitrate and nitrite comes from a variety of sources and has been thoroughly reviewed *(4)*. Cured meat and poultry only contribute a small portion of daily nitrate or nitrite intake. Much of daily dietary nitrate is consumed from vegetables (70%) and drinking water (14%) *(4)*. Much of the daily ingestion of nitrite is produced in saliva (93%) and cured meats contribute less than 5% *(4)*. Over the past decade, researchers have identified many important health and biological functions of nitrate, nitrite, and nitric oxide such as blood pressure regulation and immune response *(4)*. Furthermore, it has been suggested that dietary nitrate and nitrite should be included as part of a healthy diet *(2)*.

Conclusion

Both curing methods (traditional or alternative) provide typical cured meat characteristics, and when alternatively cured meats have sufficient antimicrobial interventions, little to no differences in food safety exist. The reactions and products responsible for meat curing are indistinguishable among curing methods. Cured meat products, whether traditionally or alternatively cured, can be safely produced and consumed.

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