Salt

Salt (sodium chloride) is the most important ingredient used in the manufacture of dried meat products. Salt exhibits many functions including suppressing microbial growth, reducing water activity, releasing salt soluble proteins, penetrating easily into meats enhancing cure penetration, flavor and showing a pro-oxidant effect. The percent salt in a meat product is not as important as the brine strength. The brine strength (sometimes referred to as water-phase salt) is the percent salt divided by the percent salt plus percent moisture in the same product. In dried meats that are manufactured with an injected or immersed brine, the salometer reading expresses the strength or salt content in the brine. A 100 degree brine contains the maximum 26.3% salt and a 50 degree brine contains 13.15% salt.

Nitrate (NO\textsubscript{3})

Potassium nitrate, or saltpeter, was the original curing agent and was generally added to the meat unintentionally as a contaminant in the salt. This chemical is very stable and must be converted to nitrite to effect meat curing. This conversion usually is done by specific microorganisms, including the *Kocuria* and *staphylococci*. Originally, these microorganisms were also contaminants in the meat, other ingredients, and/or the processing environment. Although today we realize that nitrite is the active curing ingredient and that it can be added directly to the meat, the use of nitrate salts (sodium or potassium) is still somewhat common, mainly in dried meat products. The primary reason for its continued use is that residual nitrate in dried meats can serve as a “nitrite reservoir” in non-cooked products and the conversion of nitrate to nitrite in meat processing is a slower process and can yield a deeper red cure color. For the necessary nitrate reduction to nitrite, the specific microorganisms that produce nitrate reductase always must be present and active. Nitrate is a restricted ingredient and its use is regulated by the relevant government agency in different countries.

Nitrite (NO\textsubscript{2}-)

Sodium nitrite is the active curing ingredient for typical meat curing. This is a highly reactive chemical that reacts with meat to produce nitric oxide (NO) which replaces the oxygen molecule in the meat pigment structure (heme) yielding the typical cured “pink” color when the meat product is heated. Nitrite also functions for meat flavor, helps provide microbial stability and acts as a potent antioxidant. Because of the highly reactive nature and toxicity of the nitrite, it is usually first combined with a portion of the salt prior to meat addition and should never be added to anything other than salt prior to the addition to the meat.
Curing Accelerators

Compounds such as sodium erythorbate, sodium ascorbate, ascorbic acid, sodium acid pyrophosphate, chemical acidulants, etc., are added to dried meats to enhance the curing reaction by either serving as a reducing agent, oxygen scavenger and/or reducing the product pH.

Meat Starter Cultures

Microorganisms typically are active participants in the processing of dried meats. Specific starter cultures are added in the formulation to control the product microflora and function for safety and preservation, product consistency (fermentation, drying, texture), product color and/or product flavor. Generally, the two types of starter cultures used for dried meats are the lactic acid microorganisms and the staphylococci and Kocuria (micrococci). The presence of antibiotic residues in meat may inhibit growth of the starter culture, resulting in inadequate drop in pH.

Sugars (carbohydrates)

The role of added sugars or carbohydrates in meat curing and drying often is underestimated. Carbohydrates, or “sugars,” used in dried meat processing generally consists of dextrose, cane sugar/sucrose, brown sugar, corn syrup, lactose, honey, molasses, maltodextrins, starches, etc. The added sugars function for flavor, reduce harshness of salt, lowering water activity, yield, and as a source of energy for functional and spoilage microorganisms. Added sugar type and amounts are critical for fermented products to control fermentation and final product pH. This is clearly demonstrated in pepperoni, whereby the added dextrose generally is limited to achieve a desired final pH without subsequent charring or burning when the pepperoni is cooked on a pizza.

Chemical Acidulants

Chemical acidulants are specific acids that are added to some dried meat product formulations to lower pH for various functions, including flavor, shelf-stability, color, and drying enhancement. Typically, chemical acidulants are designed or chosen to “mimic” the action of the lactic acid microorganisms (i.e., biological fermentation), thus the specific chemical acidulant demonstrates a somewhat slower release than just adding the pure acid. The slower release allows for some meat matrix formation prior to acidulation. This is accomplished by either adding a cyclic compound (e.g., glucono-delta-lactone, GDL) and/or adding an encapsulated acid. Chemical acidulants most often are utilized to replace the starter culture in a typical fermented dried product to eliminate the
fermentation phase and, thus, shorten the process.

**Oxidation Prevention Additives**

Oxidation is a major problem with dried meat products which adversely affects color and flavor. Additives that retard oxidation are classified as either primary antioxidants or secondary antioxidants. Primary antioxidants are either synthetic (BHA, BHT, TBHQ, etc.) or natural (rosemary extract, tocopherols, smoke, etc.). These primary antioxidants react with the free radicals generated in the fat oxidation process and “break” the chain reaction. Secondary antioxidants act as oxygen scavengers, synergists, and/or curing accelerators to enhance the curing reaction. These compounds include citric acid, ascorbic acid, ascorbates, erythorbates, phosphates, lactates, starter cultures, etc., and function to either “scavenge oxygen,” thereby removing it from the system; “chelate” (i.e., tie up) the catalysts that initiate oxidation; and/or create low redox potential/reducing conditions that enhance the curing reactions. Many of these compounds can act in several ways to prevent oxidation. Specific starter cultures contain the enzyme catalase that removes peroxides from the meat system (oxygen scavenger), promotes the curing reaction, and prevents rancidity development.

The proper use of any antioxidants is critical to its effectiveness. Usually a combination of primary and secondary antioxidants is employed for maximum effectiveness. The specific antioxidant should be employed for a specific meat system based on any flavor attributes, solubility, type of fat, and type of oxidation. The respective antioxidant must be stable before and after addition to the meat system and the delivery system must be appropriate for the application (e.g., fat soluble for direct addition to sausage versus water dispersible/water soluble for use in injected brines and marinades). Adding the antioxidant early in the processing is recommended for maximum efficacy as well as to achieve optimum distribution.

**Preservatives**

Certain preservatives, particularly anti-mold agents, are commonly used in dried meats since mold can grow on almost any dried meat product that is not in an anaerobic pack. Typical mold inhibitors used include potassium sorbate, propyl parabens, and cultured whey/cultured corn syrup/cultured dextrose. These latter cultured products contain naturally produced propionic acid and other organic acids that retard mold growth.