C4

Cure accelerators. L.Sair.

A new concept was introduced to cured meats by the introduction of glucono delta lactone (GDL) as an additive during the curing process (U.S. Patents 2,992,115, 2,992,116, 3,122,442, and 3,391,006).

The development of new additives to a particular food process may have great repercussions to an industry. The addition of ascorbates or erythorbates to meat curing in the United States some 10 years ago, helped greatly in the curing reaction. The ascorbate developed a reducing condition in the meat mass and the nitrite in the cure more effectively reacted with the pigments thus accelerating the cure and also yielding products which were more light stable. The addition of ascorbates resulted in cured meat products with lower residual nitrite content.

The usage of ascorbates made it possible to develop continuous production lines for the manufacture of frankfurters. This resulted in a savings in labor and an efficiency in the manufacturing operation. With the development of continuous manufacturing facilities, it became apparent that the cure color development factor during the manufacture of sausage, was a very important variable in plant processing. In a continuous operation it was learned that in a heating cycle of 30 minutes the cure color development, at times, was poor and the product may have gray cores. In a heating cycle of 1 hour, normal cure color development could occur.

The factors involved in meat curing are reasonably well established involving:

1) The meat itself.

2) The quantity of cure used.

3) The addition of ascorbate or erythorbate for its reducing properties.

4) The acidity of the meat mass.

The addition of GDL made it possible to control the pH of the meat mass. The addition of acid to a meat mass will short out the meat making it almost impossible to produce a perfect emulsion. GDL is a lactone which has the property of being neutral when being added to a meat mass and then slowly the GDL converts to gluconic acid. The addition of GDL makes it possible to produce an excellent emulsion and then with proper handling, the acidity that is formed will accelerate and perfect the cure. Very substantial quantities of GDL are being used in meat curing but under normal commercial practice in the United States it was found that GDL still tended to weaken the emulsion and as a result its use has not become widespread.

The need for a cure accelerator or an acidifier in a meat mass was established through the use of GDL. Studies were conducted to find an alternate to GDL which would yield essentially the same results but which would have an advantage in being more satisfactory from a commercial standpoint. This work led to the development of sodium acid pyrophosphate for cure acceleration (U.S. Patent 3,391,007).

Only certain acid phosphates appear to be suitable in adjusting the pH of a meat mass. This is shown in Table I.

CH

TABLE I

Phosphate Used	Oz. to 100 lbs. of Meat	pH of the Emulsion	Finished Frankfurters pH	Finished Frankfurters Visual Observation
Sodium Aluminum Phosphate	4	5.60	5.70	Good color - emulsion broke.
Sodium Aluminum Phosphate	7	5.50	5.6	Good color - emulsion broke.
Sodium Acid Pyrophosphate	7	5.65	5.75	Good color - good emulsion.
Sodium Aluminum Phosphate) Tetrasodium Pyrophosphate)	3.5 3.5	5.80	5.90	Gray - good emulsion.

The frankfurters were placed directly in a smokehouse at 250° F. (121° C.) and the heating cycle was 15 minutes.

In looking at the data in Table I, it can be seen that when sodium aluminum phosphate is used the emulsions were unstable but with almost the equivalent acidity using acid pyrophosphate, product was made with good color and with good emulsion stability. By using a 50/50 blend of acid pyrophosphate and tetrasodium pyrophosphate the pH of the meat mass was raised to 5.8 and during this heating cycle the cure color development did not occur.

In working with short schedules during the heating process, the pH of the meat mass becomes a critical factor in cure color development. This is shown in Table II where we used different proportions of acid pyrophosphate to tetrasodium pyrophosphate.

TABLE II

Sodium Acid Pyrophosphate %	Tetrasodium Pyrophosphate %	pH of the Phosphate Blend in a 1% Water Solution	Finished Frankfurters pH	Finished Frankfurters Visual Observation
zero	100	10.1	6.25	Gray with brownish cast.
25	75	8.2	6.15	Gray with brownish cast.
75	25	5.9	5.90	Slight pink with brownish cast.
87.5	12.5	5.5	5.75	Good color.
100	zero	4.3	5.67	Excellent color.

In all cases 7 ounces of the phosphates were used to the 100 pounds of meat. An all meat formulation was used and in all cases 7/8 ounce of sodium erythorbate was added to the 100 pounds of meat. The frankfurters were finished at 250° F. (121° C.) and the length of time in the smokehouse was 15 minutes.

These results point out the profound effect that the pH of the meat mass has on cure color development. They do show that if the pH of the meat mass is reduced sufficiently, excellent cure color development can occur within a 15 minute time span with good emulsion stability.

Various acidifying agents have been tested for cure acceleration and in almost all cases the acidifying agents will weaken the stability of the meat emulsion. It is not completely clear why the acid pyrophosphate works so effectively. It appears as though the pyrophosphate radical has a function in maintaining qualities of the meat protein while the acidity of the phosphate salt has the function of reducing the pH of the meat mass to give cure acceleration.

In the United States, the law states that we can use 1/4 ounce of nitrite to 100 pounds of meat. As you are aware, there has been publicity concerning the safety of nitrites in meat curing from the standpoint of health. Certain scientists are concerned with the residual nitrite content of cured meats.

One approach that has been suggested is to reduce the amount of nitrite that is added to the meats. The usage of a lower level of nitrite results in a poorer finished color and also the cure color development time is increased. Rather than go to a lower nitrite input we can ask ourselves as to whether it would not be a better approach to use the cure more effectively. This can be accomplished by having a proper reducing condition and acidity in the meat mass to utilize the cure effectively and thus reduce the residual nitrite.

A great deal of information has developed both in the United States and Europe showing that the usage of GDL will reduce the residual nitrite content of the finished product. A similar effect is obtained by the addition of acid pyrophosphate. In a commercial run it was found that the control frankfurters had 61 ppm residual nitrite while the addition of 8 ounces of acid pyrophosphate to the 100 pounds of meat reduced the residual nitrite content to 33 ppm.

In a second commercial test, the control frankfurters had a pH of 5.90 with a residual nitrite content of 75 ppm and the finished frankfurters containing 8 ounces of acid pyrophosphate had a pH of 5.80 with a residual sodium nitrite content of 55 ppm.

The Consumer and Marketing Service (C&MS) of the United States Department of Agriculture is permitting commercial testing of acid pyrophosphate under Federal Inspection. We are now proceeding with a one month production run at a plant in Eastern United States. In this particular plant they have a continuous smokehouse and their cooking and smoking cycle involves 36 minutes. At times the cure color development has been unsatisfactory. By using 8 ounces of acid pyrophosphate the color development was excellent and in the first run using this system, the residual nitrite content of the frankfurters was reduced from 72 ppm to 40 ppm. Inasmuch as the United States Food and Drug wishes to reduce the residual nitrite content of cured meats, the usage of an acidifier or cure accelerator is being looked at with much interest.

The addition of acid pyrophosphate to sausage gives a positive approach to pH control. The emulsion stability is excellent, the peelability of the product appears to be improved, and there are no adverse taste effects. The bacteriology of the products is being evaluated but the results would indicate somewhat better stability. The usage of 8 ounces of acid pyrophosphate to the 100 pounds of meat in the manufacture of sausage will reduce the residual nitrite content of the finished product by 25 to 50%. The lower pH of the meat mass makes it possible to accelerate cure color development to any desired extent.