# Growth of *Clostridium perfringens* on Natural and Organic Frankfurters

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**Summary and Implications**

Eight of ten commercial brands of natural and organic frankfurters showed greater growth by inoculated *Clostridium perfringens* than that observed for conventionally-cured control frankfurters. These products also demonstrated a wide variation of inhibitory activity. This means that natural and organic processed meats may require additional protective measures in order to consistently provide the same level of safety from bacterial pathogens that is achieved by conventionally-cured meat products.

**Introduction**

Because of the growing demand for "natural" and "organic" products, many meat processors have begun to manufacture ready-to-eat (RTE) processed meats with natural sources of nitrite. These sources include celery juice, celery powder and sea salt. These products are manufactured to simulate traditionally cured meat products but without direct addition of nitrite. Because nitrite is a preservative, it is not permitted in natural and organic meat products. However, the "natural" curing process has been shown to result in less nitrite than conventionally cured products. The major concern with these products is that they do not contain formulated nitrite in concentrations known to be highly effective in inhibiting the growth of *C. perfringens* and many other foodborne pathogens. As a result, these products are more susceptible to foodborne pathogens.

The objective of this study was to quantify the potential for *C. perfringens* growth in frankfurters manufactured to simulate traditionally cured products but without the direct addition of nitrite or nitrate and in products to which no nitrite/nitrate source was used.

**Materials and Methods**

*C. perfringens* strains ATCC 10258, 3124 and 12917 were obtained from the Food Safety Research Laboratory at Iowa State University. The organism was cultured in fluid thioglycollate medium and sporulation was induced in Duncan-Strong sporulation medium. The spore crop was harvested by centrifugation and then re-suspended in physiological saline. The three strains were combined and vortexed just before inoculation took place. Ten brands of frankfurters labeled as "no nitrites or nitrates added" were evaluated. Two brands (A and B) were traditionally cured and used as controls. Brands C, D, E, F, G, H, I and J were naturally cured using sea salt or celery juice. Brands K and L were uncured in the sense that these two products do not have a nitrite/nitrate replacement. A negative control of each brand was also evaluated to ensure that none of the brands had *C. perfringens* present before inoculation. Each 25-gram sample was inoculated interiorly with 0.1 ml of *C. perfringens.* The concentration of the 3-strain *C. perfringens* cocktail approximately 7 log and resulted in 1-2 log in the inoculated products. Inoculation was achieved using a needle. After packages were sealed under vacuum, samples were heated to an internal temperature of 71ºC in an effort to inactivate vegetative cells. All products were chilled following the heating step. After the product reached an internal temperature of 7.2ºC, the product was stored at room temperature. Three replications with two samples of each brand within the replications were performed with the exception of Brand I (two replications were performed for Brand I).

**Microbiological Analysis**

Sampling was conducted on Day 0, 1, 2, 4, 6, 8, and 10 following inoculation. These sampling days were determined by results from preliminary studies. Sampling was achieved by blending each 25-gram sample with 225 ml of 0.1% peptone water. Each sample was stomached for 30 seconds. All blended samples were maintained on an ice slurry. Appropriate dilutions were plated in duplicate on perfringens agar with TSC and egg yolk emulsion. Agar plates were incubated at 37°C in anaerobic jars with Gas Pak palladium catalyst envelopes for 24 hours. In an effort to ensure the anaerobic jars were functioning properly, a positive control and an anaerobic indicator was included in each jar.

**Results and Discussion**

Figure 1 illustrates the *C. perfringens* numbers recovered for each brand of frankfurters on day 4 of sampling after inoculation. It is clear that Brands A and B (controls) had little or no growth from the initial 1-2 log inoculation. This is most likely due to the fact that these two products are traditionally cured and contain greater concentrations of sodium nitrite. Brands C through J are naturally cured products. As a group, there is wide variation but 6 of the 8 products resulted in greater growth than the controls. Brands G and H are natural/organic products showing *C. perfringens* growth that appears to be much lower than the other natural/organic brands and further inspection of the labels show that Brand H contains

potassium lactate, which is an effective antimicrobial agent. It is not clear why Brand G did not show greater growth. Brands K and L appear to have relatively rapid growth patterns that are similar to each other. These two brands are marketed as organic frankfurters but do not have any source of nitrite or nitrate and were not manufactured to simulate traditionally cured products with a natural cure. Brand I had a rapid growth pattern similar to Brands K and L, but is naturally cured, thus there is virtually no inhibitory effect of the natural cure in this product. These results show that the majority of natural and organic frankfurters that are commercially available are at greater risk for growth of *C. perfringens* than conventionally cured frankfurters. This is most likely due to the reduced amounts of nitrite produced by the natural curing method used for these products, an observation that has been reported in earlier work. Further, there is wide variation in the potential for pathogen growth among the commercially available natural/organic frankfurters meaning that the bacterial safety of these products is not well understood or well controlled. Consequently, development of supplemental treatments to increase the level and consistency of antimicrobial protection in these products is important to provide consumers with the degree of safety that they have come to expect from conventionally cured processed meats.

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**Figure 1. Population of inoculated *C. perfringens* on the interior of frankfurters after 4 days at room temperature (Brands A and B are conventionally cured. Brands C-J are naturally cured. Brands K and L do not have a nitrite/nitrate replacement. Brand H contains sodium lactate in addition to the natural cure.)**