

# FoodSafety

magazine

Science-Based Solutions For Food Safety and Quality Professionals Worldwide

**Home**

**Current Issue**

[Issue Index](#)

[News Bites](#)

[Product Showcase](#)

[Advertiser Index](#)

**Exclusive Web Content**

**Search/Past Issues**

**Industry Resources**

**About FSM**

**Subscribe**

[Printer-friendly version](#)  
[Forward-to-a-Friend](#)



## CATEGORY FEATURE: MEAT Low-Oxygen Packaging with CO: A Study in Food Politics That Warrants Peer Review

By [Randall D. Huffman, Ph.D.](#) and [Janet M. Riley](#)

December/January 2007

Maintaining meat's color throughout its shelf life has been a perennial challenge for the meat industry. Numerous systems have been tried with varying degrees of success. A low-oxygen packaging system that uses minute amounts of carbon monoxide (CO) either in a master bag around meat packages or in the gas mix in modified atmosphere packages offers new options for retailers—options that have been increasingly embraced over the last few years.

But the maker of a competing technology that uses rosemary extract as part of a high oxygen environment to maintain meat's red color petitioned the U.S. Food and Drug Administration (FDA) in 2005 to disallow the technology. At the same time, the petitioner launched an aggressive media relations campaign disparaging its competitors in the case-ready packaging market. This issue has become a remarkable study in the intersection of science, regulatory oversight and media influence.

An examination of the history of the issue shows that the low-oxygen CO system was developed in response to consumer demand for fresh, appealing and in-stock case-ready products, packaged in convenient ways, with the sensory traits that will ensure repeat purchases. This packaging system has been subjected to careful scrutiny by federal regulatory agencies and leading food scientists and microbiologists and should be permitted the opportunity to succeed or fail in the marketplace based upon its merits.

### **Emergence of Case-Ready Meat Products**

Changing consumer demographics, coupled with new regulatory pressures and food safety concerns in the 1990s, drove processors and retailers to experiment with case-ready meat products. These products are cut into consumer-ready portions at federally inspected facilities, packaged and typically sold under brand names that consumers can seek or reject when making purchasing decisions.

The shift to case-ready made sense. The consumer of the '90s sought convenient cuts that were always available. At the same time, in the face of unparalleled food safety pressures and high profile recalls and foodborne illness outbreaks, some retailers preferred to shift processing and handling to a centralized location where

products could be cut, processed and packaged in a more controlled environment.

This concept was not new—the poultry industry has sold prepackaged and branded chicken in increasing volumes throughout the 1990s. Chicken maintained essentially the same color throughout its shelf life—a fact that made it ideal for case-ready. By 2002, 83 percent of chicken was sold case-ready, and by 2004, that number had climbed to 95 percent. By contrast, only 23 percent of beef and 66 percent of ground beef products were sold case-ready in 2004.

But the “will” was there. case-ready offered an array of other benefits—like preventing out of stocks. Research showed that case-ready products were out of stock far less often than store wrapped packages because these products facilitated better inventory management.

The presence of myoglobin in red meat, however, made case-ready packaging more technically challenging for beef and pork products. Historically, red meat products were cut or ground in the retail store and packaged on styrofoam trays with oxygen permeable films that allowed the bright red “bloom” that came from exposing these meat cuts to oxygen. Consumers came to associate this cherry red color with freshness. Processors and retailers rued the fact that the very contact with oxygen that gave meat the impression of “freshness” also caused it to degrade quickly due to oxidation. Red quickly turned to brown, meat flavor degraded and the product could not be marketed within a relatively short period of time.

Attempts to use vacuum packaging as a retail display technique to lengthen shelf life presented huge obstacles. Even though the vast majority of wholesale primals of beef and pork has been packaged and distributed in large vacuum bags for decades, without oxygen in the retail display package, meat products appeared in their true state: purple. Consumers expect to see red, and they mistakenly equate a red color with freshness. Although vacuum packaging of retail case-ready may be the most effective and cost efficient method, the package generally does not hold appeal for consumers.

High oxygen modified atmosphere packaging (MAP) offered consumers the color they expected and offered retailers some of the inventory control benefits of case-ready systems. Consumers also could choose the brands they prefer. However, the presence of oxygen in the MAP packaging still delivered a shorter shelf life than retailers would otherwise like due to the degradative effects of high oxygen concentrations in meat products. Antioxidant ingredients, such as rosemary extracts, were added in some cases to extend shelf life of products packaged in high oxygen for a few extra days.

Then, U.S. meat processors took their cue from Norway, where researchers found that by adding minute amounts of carbon monoxide into the gas mix in a low-oxygen modified atmosphere package, they could not only offer the extended shelf life that comes with low-oxygen modified atmosphere packaged meat, but also prevent the oxidative processes that result in off-flavors, off-odors and browning that ordinarily occur. When meat turns brown, flavor also is lost. Thus, by preventing oxidation, meat’s fresh flavor is maintained longer—a distinct benefit to the consumer.

Research has shown that this system could offer shelf lives that are similar to vacuum packaged products and higher than those of high oxygen packaged products. Research also shows that if temperature abuse occurs, while the meat would maintain its red color, other obvious signs of spoilage would make it nearly impossible for consumers to eat the product. Chief among these signs: a bulging package, a slimy appearance and an unmistakable odor associated with bacterial growth.

Only later in June 2006 would Texas Tech University researchers report that low-oxygen packaging MAP systems with CO could inhibit the growth of pathogens that were deliberately inoculated for research purposes. The lower the load of pathogens, the less risk there is to the public health if the product is undercooked or mishandled.

#### **How It Works**

Red meat contains the pigment myoglobin. In the absence of oxygen, myoglobin is in the “deoxymyoglobin” state (without oxygen) and is naturally “purple.” When oxygen is exposed, it becomes oxymyoglobin and develops a red color. Over time, a continual exposure to oxygen diminishes the ability of the meat to maintain the oxymyoglobin and the majority of the meat pigment will convert to metmyoglobin which has a characteristic brown color.

When meat is exposed to small amounts of carbon monoxide, the carboxymyoglobin pigment is formed. This pigment is more stable than oxymyoglobin, and it has a red appearance that is virtually indistinguishable from oxymyoglobin to the naked eye, as well as to more sensitive spectrophotometric methods. By using CO in a modified atmosphere, the need for oxygen to achieve a red color is eliminated, thus the opportunity to eliminate the detrimental product effects that oxygen imparts to the product. Adding small amounts of CO will not convert brown meat back to red, but it will maintain the red color that is present when the product is packaged in the modified atmosphere.

### **Regulatory Acceptance**

The FDA has jurisdiction over packaging, packaging gases and food additives. Because packaging gases contact food, but do not become part of the food product, with proper and well-documented evidence, these gases can be accepted under FDA's Generally Recognized as Safe (GRAS) provisions. When an entity seeks GRAS status for substances used with meat or poultry products, it must notify FDA of the use and file a petition (known as a GRAS Notification) with supporting evidence. GRAS Notifications are public, but do not go through the cumbersome and lengthy public rule-making process. FDA reviews GRAS Notifications and informs the petitioner if it has any questions regarding the submission. FDA often will have questions, which results in further data collection and ex-change of information. Both GRAS substances and food additives must be equally safe, but food additives go through a lengthier review because the basis for the safety determination may not be widely known or accepted in the scientific community.

Because meat products are regulated by USDA, when a regulatory action occurs at FDA that directly affects a meat product—like acceptance of a packaging system that includes minute amounts of carbon monoxide—USDA also reviews the process to determine its suitability for use under meat inspection regulations. It is common for the two agencies to communicate and exchange information throughout the process, which is entirely transparent to the public. This dialogue occurred between USDA and FDA in considering GRAS petitions for low-oxygen MAP packaging systems with CO.

In 2001, Pactiv Corp. submitted the first such GRAS petition for its low-oxygen CO MAP system. Pactiv's system places a package or packages of case-ready meat into an outer barrier bag that contains small amounts of CO in a gas mixture. That outer bag remains intact throughout distribution of the meat. At retail, the packages of case-ready meat are removed from the outer bags (i.e., from the CO) and placed on display for sale to consumers. The FDA accepted this system in 2002.

In 2004, Precept Foods sought GRAS status for a system in which a gas mixture containing CO was included in the headspace of the MAP package. This system was accepted in 2004 and products were offered in numerous markets where they were well received. All products using this technology bore use-by dates to inform the consumer. Subsequently, in 2005 a notification submitted by Tyson Foods to use a system similar to Precept's with a slightly different application of the gas mixture was accepted by FDA.

After its own consideration regarding suitability in meat products and after posing follow-up questions, USDA also accepted the technology in each of the three GRAS submissions. At this point, the evidence was clear that FDA and USDA were confident in the safety and appropriateness of low-oxygen systems using CO. It also became clear to the maker of a competing technology that the meat industry was embracing a system that had the potential to make its product—rosemary extract—obsolete in fresh meat applications.

### **Take It to the Press**

Within a month of FDA's third GRAS letter, Kalsec, Inc., submitted a petition, arguing that the agency erred on the occasions that it accepted the GRAS notifications. Although the petition was submitted to FDA, the message was aimed at the media. With a lead paragraph that read in part, "...FDA was asked today to rescind its illegal acceptance of the use of carbon monoxide in case-ready meats. The use of carbon monoxide deceives consumers and creates an unnecessary risk of food poisoning by enabling meat and ground beef to remain fresh-looking beyond the point at which typical color changes would indicate aging or bacterial spoilage," Kalsec hinted at the war that would be waged on the technology over the next year by a Washington, DC public relations agency.

A dedicated website, [www.co-meat.com](http://www.co-meat.com), was unveiled to offer one-stop shopping for journalists. On the home page, Kalsec stated, "The use of carbon monoxide in fresh

meat causes a chemical reaction that creates a substance that makes the meat look red and fresh beyond the time it is safe to eat." In its media outreach, the presence of use-by dates was consistently ignored. Also ignored was the fact that when consumers bought chub-packed ground beef—packaging that offered consumers absolutely no visual clues about color—consumers could only rely upon use-by or sell-by dates. And yet there were no patterns of complaints for either chub-packed ground beef or low-oxygen MAP packaging with CO.

Station after station—from national networks on down to small local affiliates—contacted the American Meat Institute (AMI). Claims of deception and food safety risks were advanced in detail, an AMI spokesperson offered a rebuttal sound bite and reporters showed their own examples of meat products that had been left out of refrigeration on counters for extended periods of time. Not surprisingly, the packages bulged. Not surprisingly, the meat was still red.

"What no reporter did on camera was open the package and attempt to maintain a telegenic smile," says AMI Foundation President James H. Hodges. "Had they done so, the odor would have sent a strong and unmistakable message to the consumer that the product was spoiled—a fact that the bulging packages also signaled." But according to Hodges, the issue of meat packaged in this way becoming spoiled has been manufactured to add to the controversy. "Distribution systems today ensure with an extremely high degree of accuracy that meat is maintained at proper temperatures during distribution and in the retail meat case," he said. "Use-by dates on all of these packages provide additional information."

In public communications, Kalsec's agency also argued that the European Union had banned the practice—a fact that was never researched thoroughly and never reported accurately in context. In 2001, the European Scientific Committee on Food found the packaging system to be safe and said "there is no health concern" provided temperature controls are followed. Subsequently, a European political body made the decision not to allow the packaging system. This is the American equivalent of FDA giving a technology its scientific assessment and approval, while politicians in Congress step in to ban the technology.

In defense of the media, one ambitious reporter, Jim Strickland at WSB-TV in Atlanta, broke out of the mold. He collaborated with Dr. Mike Doyle, director of the Center for Food Safety at the University of Georgia, who inoculated ground beef in low-oxygen MAP packages with CO with doses of the pathogen *E. coli* O157:H7. Traditional, store-wrapped packages also were inoculated. Both were temperature abused. According to the report, which originally aired July 17, 2006, after four days, *E. coli* O157:H7 in the conventional packages grew to an average 54,000 cells per gram. But *E. coli* O157:H7 counts in the MAP packages were at less than 3,000 cells per gram. The data suggested that growth of *E. coli* O157 was deterred in low-oxygen CO packages when compared to the control packages. Though the analysis was small and limited, the results generally agree with the larger study done at Texas Tech just a month earlier—a study that has received very limited press coverage.

Media coverage of the issue was fueled by the engagement of consumer organizations in the controversy. Most notably, the Consumer Federation of America issued comments in support of Kalsec's position, buttressed claims of consumer deception and made aggressive calls for labeling. Some members of Congress also engaged in the issue, with Michigan lawmakers (where Kalsec is based) leading the charge.

The industry responded with statement after statement detailing the safety and benefits of the technology. Industry also argued that mandating labels for this technology when they are not required for any other packaging system or packaging gas is arbitrary. Snack foods, fresh produce, dairy products and a host of other foods all use gases to maintain the qualities that consumers desire.

Third-party experts from across the nation echoed industry messages. "I don't think that carbon monoxide is deceptive at all, certainly not from a safety perspective," Doyle said. "I think that carbon monoxide packaging technology deserves an award. This is a profound idea."

Dr. Melvin Hunt, professor of meat science at Kansas State University, has been equally supportive of the technology—and equally frustrated by the controversy that has swirled around it. "A close look at the media scare shows motives that are as transparent as carbon monoxide itself. But carbon monoxide technology has a real benefit to consumers. The only benefits generated by the unfounded safety

allegations are to the company that stirred the controversy—and to the media outlets that benefit from the attention-grabbing story.”

Even the well-respected publication of the Institute of Food Technologists, *Food Technology*, printed a back page “perspectives” column, authored by four leading scientists who commented on the science surrounding this controversy. One significant quote from this article was “the claim that CO packaging will result in unsafe products is not scientifically sound.”

### **Consumer Attitudes**

Despite sustained media coverage of the issue over the last 12 months, consumer confidence in beef safety has remained both constant and high, according to industry data.

In late September 2006, the Consumer Federation of America released polling data that suggested that consumers did not like the idea of the technology. Experts in the field of polling point out, however, that consumers were only asked about the practice of adding carbon monoxide to meat. They were not told how and why the technology is used, nor were they informed that the technology was accepted by both the FDA and USDA, or that it offered distinct consumer benefits.

One question asked in the poll—but not highlighted in the press release—is that the single most important factor consumers reported using in evaluating the freshness of meat was the use-by or sell-by date, followed by smell, followed by color. According to a subsequent poll of 1,000 consumers conducted in November 2006 by Opinion Dynamics Corp. for AMI, only 9% of consumers were very or somewhat likely to buy a meat product that seemed to be excessively bulging in the retail case. Even more importantly, 95% of consumers were very or somewhat unlikely to prepare a meat product that even though red in color, was beyond its use-by date and had a noticeable odor when opened at home. These findings bolster the claim that low-oxygen MAP packaging systems with CO are not misleading and that the use-by dates on the packages, coupled with other sensory factors, all contribute to the decision making process that consumers engage in when preparing product in the home. When handled and cooked properly in the home, these products are just as safe as other products offered in the marketplace, including the traditional packaging techniques.

### **The Future**

The FDA is currently reviewing the multiple submissions filed by Kalsec and the responses filed by the makers and users of this technology. As it should, FDA is taking time to ensure that its decision is based upon the available scientific information. If the testimonials from university experts in support of the technology are any indication of what FDA scientists will find in the literature, the agency will affirm its decisions and reject Kalsec’s petition.

If there is a lesson to be learned by the food safety community from the media coverage and regulatory activity over the past year it is this: Good science must be coupled with good, early and frequent communications to multiple audiences in an effort to ensure that government, Congress, consumers and the media have what they need to make thoughtful decisions in the public’s interest.

**Randall Huffman, Ph.D.** is Vice President of Scientific Affairs for the American Meat Institute Foundation (AMIF). Huffman manages the AMI Foundation’s food safety research agenda, assists members in improving food safety and quality and serves as the liaison between AMI and various scientific organizations. Earlier in his career, he was director of technical services at Koch Industries, Inc., in Wichita, KS where he had responsibilities for product development and food safety with the Koch Beef Co., and he served as vice president of technical services at Fairbank Farms in Ashville, N. Y., a case-ready meat processor. Huffman can be reached at [rhuffman@meatami.com](mailto:rhuffman@meatami.com).

**Janet M. Riley** is senior vice president of public affairs and professional development at AMI, where she oversees public communications and issue management strategy. Prior to joining AMI, Riley served as a media spokesperson for the American Health Care Association. She received her B.S. from Northwestern University’s Medill School of Journalism. Reach Riley at [jriley@meatami.com](mailto:jriley@meatami.com).

