

Transportation:

The Squeaky Wheel of the Food Safety System

By Larry Keener

No matter whether they are genetically modified, certified organic or grown using conventional farming methods, no matter if partially processed for use as food ingredients or canned, food commodities and products have a significant commonality: They require multiple steps in their transportation between point of origin and point of use. The transportation of foods and commodities involves every conceivable form of conveyance, including planes, boats, barges, railcars, tankers, trucks



Photo courtesy: Food Marketing Institute

and even pack animals. Foods and food ingredients are shipped frozen, refrigerated and at ambient temperatures. They are shipped whole, by the bushel, in bunches, bundles, or in boxes, stretch-wrapped on pallets. Poly-lined barrels, buckets or baskets are frequently used to transport an assortment of powders, purees and pastes. Foodstuffs are shipped in open-bed gondolas, dry-box sea containers, and in the cargo holds of ocean-going freighters.

The fact that there are so many types of foods with so many container, temperature and handling requirements and so many modes of transportation available to the modern food company, it isn't difficult to see that, independent of the mode of transportation, foods and food ingredients are susceptible to abuse and/or contamination during transportation and stor-

age. While there are limited data on food safety failures that are directly attributable to transportation and storage practices, investigation of several major incidents have identified these processes as the root cause of failure:

- In 1989, multiple outbreaks of staphylococcal food poisoning caused by canned, imported mushrooms was attributed to post-harvest and pre-processing collection and transportation practices used in the Peoples Republic of China.
- In 1994, a salmonellosis outbreak affecting 224,000 people was blamed on cross-contamination of pasteurized ice cream transported in tanker trailers that had previously hauled non-pasteurized liquid eggs.
- In 1995, shipments of vegetable oil from heated rail tankers were found contaminated with the heat transfer medium used for heating the railway tankers.
- In 1997, several bodies of deceased stowaways were found in three ships carrying cocoa beans and raw sugar.
- In 1999, a major illness outbreak among children and young adults in the European Economic Community was attributed to fungicide-contaminated pallets used for transportation and storage of product packaging materials, resulting in the recall of millions of cases of the implicated product.

Based on industry experience, the overall numbers of incidents or outbreaks attributable to transportation failures appear to be vastly underreported. Therefore, the magnitude of the economic, public health or societal impact of transportation food safety failures is also underestimated. Conservative estimates place the financial impact at \$2 billion annually. Judging by congressional response to this issue, it is clear that the societal impact of transportation food safety failures is viewed as substantial.

The Spokes of Regulation

In 1989, a series of mass media news reports revealed that some trucking companies carried garbage and chemicals on the same truck with food. In the following year, congressional hearings into food transportation safety also identified concerns about a practice called "backhauling," the custom of trucks carrying garbage or other contaminants after delivering food and then returning to food delivery. To address

these concerns, Congress passed the Sanitary Food Transportation Act (SFTA) of 1990 (49 USC 5701). Significant congressional findings related to the passage of SFTA were the following: The American public is entitled to receive food and other consumer products that are not made unsafe because of certain transportation practices. The U.S. public is threatened by the transportation of products potentially harmful to consumers in motor vehicles and rail vehicles that are used to transport food and other consumer products. The risks to consumers by those transportation practices are unnecessary and such practices must be ended.

SFTA also required that the U.S. Secretary of Transportation issue a regulation to promote the safe transportation and storage of food by truck and rail. The act was roundly criticized for being overly narrow in its scope and for failing to consider the food safety transportation issues attendant to the many other modes of food transportation, other than motor and rail vehicles. It is also noteworthy that in the intervening years since the passage of SFTA, the Secretary of Transportation has failed to promulgate the regulation necessary for its implementation and enforcement.

In 1997, the National Economic Crossroads Transportation Efficiency Act (NEXTEA) included provisions to transfer primary oversight of food transportation safety from the U.S. Department of Transportation (DOT) to the U.S. Food and Drug Administration (FDA). After much debate and political wrangling it was concluded that the DOT lacked the requisite expertise necessary for overseeing food transportation safety and that food safety inspections could be incompatible with the DOT's transportation safety inspections. NEXTEA required the development and implementation of regulations to ensure the safe transportation and storage of food, whether the food was transported by road, rail, air or sea. Key provisions of this legislation include the following:

- Restricting transportation of cargo commingling food and hazardous materials
- Requiring regular information-sharing between shippers and carriers about food handling
- Mandating specific requirements for shippers and carriers concerning record-keeping, reporting, and compliance with inspections
- Requiring training for inspectors to help them identify potential hazards to food safety
- Requiring DOT inspectors to notify FDA and the U.S. Department of Agriculture (USDA) of possible food contamination
- Preempting state or local statutes concerning food transportation safety, if these laws are weaker than federal law

Historically, oversight of food transportation safety has been the responsibility of the USDA and FDA. USDA has responsibility for meat and poultry safety under the Federal Meat Inspection Act and the Poultry Products Inspection Act, respectively. FDA has authority over adulteration and misbranding food in interstate commerce under the Federal Food, Drug and Cosmetic Act (FD&CA) and the Public Health Service Act. FDA has more than 4,000 food safety inspectors and has primarily enforced food transportation safety by invoking the "may have clause" (section 402(a) [4]) of the FD&CA. Under the "may have clause," which states that a food is considered adulterated if it has been prepared, packed or held under conditions whereby it may have become contaminated, has been the agency's primary enforcement tool in the area of food transportation safety.

Another noteworthy regulation with implications for food safety includes DOT regulations under the Hazardous Materials Transportation Uniform Safety Act of 1990. These regulations

stipulate that a carrier may not transport hazardous materials, labeled as poison, in the same vehicle with food or animal feed. Moreover, these regulations mandate that railcars carrying poisonous materials that show any leakage must be cleaned after unloading before such railcars can be returned to service, unless the railcar is dedicated for the exclusive transport of poisonous materials.

It is abundantly clear that it has long been regulatory and congressional intent to provide a statutory basis for preventing the contamination or adulteration of foods while they are in the transportation and distribution system. Nonetheless, foods in the transportation system remain at risk of abuse, incidental or otherwise.

Planes, Trains and Potential Hazards

Abusive handling and storage have the potential to compromise food or food ingredients to the extent that they are rendered unfit and unsafe for use as food for human consumption. General abuse, where the safety of the food is at stake, most frequently results from one of following mechanisms: sabotage or tampering, temperature abuse or cross-contamination.

Sabotage and Tampering. Since the notorious Tylenol autumn of 1982—and the rash of copycat incidents that immediately followed—containing the threat of tampering or sabotage has increasingly gained in importance to the food processing industry. Further, the events of Sept. 11, 2001, acutely sharpened the nation's focus on protecting and preventing the food supply from being used as a means for perpetuating mass destruction. Due to the great penetrating power of leading national brands into homes and public institutions, foods and beverages are potential vehicles for disseminating harmful chemicals or biological agents. Consider that a tanker load of corn syrup destined for use in the manufacture of soft drinks has the potential of delivering upwards of 600,000 tainted containers of product into hands of unsuspecting consumers. Preventing this outcome is dependent upon denying terrorist and other criminals the opportunity and access to the food supply.

Since the Tylenol incident great strides have been taken by the food industry to provide tamper-evident packaging for retail food items. The same is true, but to a lesser extent, for foodservice products. However, bulk shipments of foods and food ingredients remain at risk. Measures generally have not been taken to provide these shipments with tamper-evident technologies. Providing food transportation vehicles with tamper-evident locks and seals will certainly help to minimize the risk. Moreover, packaging materials suppliers should be encouraged to provide innovative packaging formats that will serve to deter product tampering of bulk shipments. For example, the use of active packaging (flexible packaging that changes color when its integrity has been compromised) will greatly enhance the ability to detect and isolate potentially dangerous product. Another recently introduced packaging technology provides tamper evidence for bulk (6,000 gallon) foods stored in flexi-tank systems.

Training is another critical element of programs that are designed to prevent and detect the deliberate abuse of the food supply. It is imperative that all workers at all levels along the food supply chain are trained to observe, respond and report any suspicious circumstances involving foods, no matter how trivial or insignificant they may appear. If the condition is abnormal and there is no immediate reason why the abnormality should exist, the situation should be brought to the attention of management, and ultimately to the appropriate enforcement authorities for follow-up investigation.

The National Infrastructure Protection Center and the Office of Homeland Security (OHS) have identified the food

supply system one of the nation's top eight critical infrastructures. Correspondingly, these organizations have made security of the food supply a national priority. Likewise, the food processing industry has responded by providing security measures that are intended to protect and preserve the integrity and security of the food supply. A significant investment has also been made by OHS, FDA and USDA in providing for improved inspection of food shipments arriving at the nation's more than 300 ports on an hourly basis.

Temperature Abuse. From a food safety and quality assurance perspective, the most significant threat to the integrity of the food supply is from temperature abuse during transportation. Refrigerated foods are rendered microbiologically stable by, among other measures, reducing their temperatures to levels (<40F) that will not readily support the proliferation of pathogenic microorganisms within the product matrix. Processors of refrigerated and frozen foods invest heavily in refrigeration equipment, temperature-control devices and monitoring equipment in order to preserve their products. However, once the products leave the manufacturing facility there is good evidence that they are almost immediately exposed to temperature abuse in the transportation system.

Fortunately, for most over-the-road shipments of domestically produced foods the distance traveled is typically within a radius of 500 miles of the point of manufacture. The short duration of these trips often is the preserver of the product quality and a safeguard for the public health. But not in all cases. As can be seen from the histogram based on work by CSIRO's Food Science Australia, fresh produce and mayonnaise were subject to significant abuse during a relatively short trip (Figure 1). The data show that the overwhelming majority of the products involved in this shipment, both of which are capable of supporting the outgrowth of pathogens under the proper conditions, were clearly abused in a short (12-hour) over-the-road trip between the supplier and end user.

Longer voyages are, of course, frequently a necessary element of the global food supply network. Fruit and vegetables, as well as meat and other processed food, arrive in U.S. ports daily from countries around the world. These materials may have spent weeks, if not months, aboard the delivery vessel. Work done by Tanner and Flores in tracking the temperature of frozen fish for a period of 20 days while aboard a sea container demonstrates the impact of voyage length on the container's ability to maintain temperature (Figure 2). In this particular study, the refrigeration system failed early on in the voyage and it is exquisitely clear from the tracking data that the quality, and perhaps safety, of the fish involved in the study had been severely compromised due to temperature abuse.

Unfortunately, most food shipments in the U.S. are not monitored as closely as are the products involved in the CSIRO studies. Consequently, companies with products in the cold chain distribution system are routinely requested, via variance reports, to provide disposition for products that arrive at their destinations having exceeded specification for storage or transportation temperature. In far too many instances quality control (QC) and food safety staff are requested to provide dispositions for these products in the absence of reliable data. Is this a food safety issue or is this a quality issue? Fortunately, the available data, though sparse, suggest that the majority of these variances to specification only involve loss of product quality. The estimated cost to the food industry for these losses in product quality and shelf life are well over \$2 billion per year.

Cross-Contamination. Cross-contamination between product during shipment and from transport vehicles from prior shipments remains a significant issue. It was this issue that singularly prompted Congress to pass SFTA. The most significant

means for cross-contamination is by way of less-than-full-load (LTL) shipping practices.

A truck, train or other carrier arrives at your receiving dock and, to your dismay, you learn that your freshly boxed vegetables have been commingled during transportation with freshly boxed raw meats and assorted bags of food-grade chemicals. Sound unrealistic? Unfortunately, this scene is played out on a daily basis for food companies that ship or receive products on a less-than-full-load basis. In a related situation, consider receive-

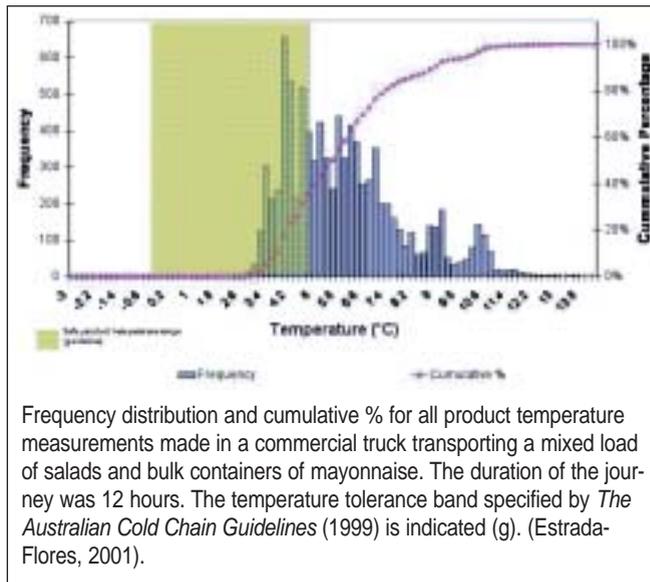


Figure 1. Temperature data collected from a commercial truck hauling a mixed load of fresh-cut produce and mayonnaise.

ing a container from your trucking company that is "broom clean," but reeks from the odors of industrial chemicals. Do you load this truck with your cellophane-packaged cookies? If so, what are the risks to the consumer and to the business? This situation, too, is frequently a daily dilemma for the transportation, food safety and QC staff of many food processors.

In the first instance, it is clear that product from the three classes identified— fresh produce, fresh raw meat and assorted chemicals—are absolutely incompatible with each other in terms

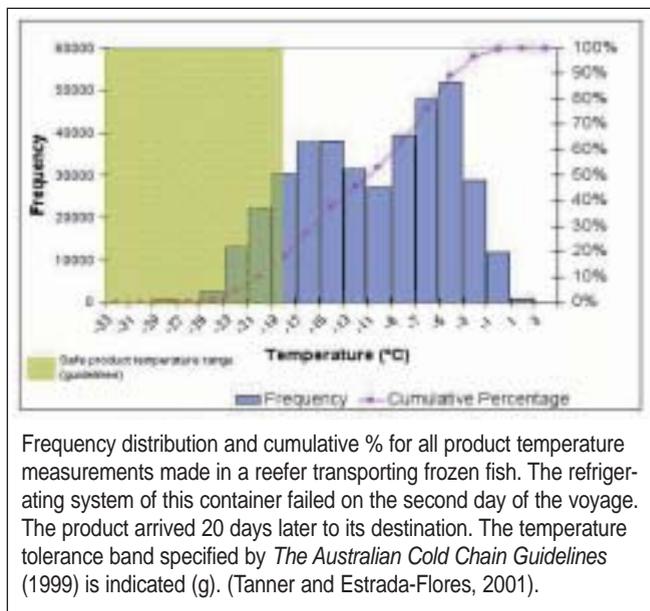


Figure 2. Temperature data collected from a sea container transporting frozen fish.

Product Combinations

		BACK-HAULED PRODUCTS					
		Dry Goods	Frozen Boxed Meat	Fresh Boxed Meat	Fresh Produce	Industrial Equipment, Botanicals and Chemicals	Paper Products
OUTBOUND PRODUCTS	Dry Goods	4	3	2	2	1	4
	Frozen Boxed Meat	3	4	2	2	1	4
	Fresh Boxed Meat	2	2	2	2	1	4
	Fresh Produce	2	2	2	2	1	4
	Industrial Equipment, Botanicals and Chemicals	1	1	1	1	1	4
	Paper Products	4	4	4	4	4	4

Source: International Product Safety Consultants, Inc.

Table 1. Product handling matrix with assigned hazard classifications.

of food safety. However, trucking company staff, drivers and others involved in the delivery chain typically are not trained to understand the risk of cross-contamination. Their function is to deliver product and to minimize the number of trips made with an empty truck. Similarly, the situation involving the truck arriving at your docks reeking of industrial chemicals is a result of lack of training. The driver has apparently swept the container to remove trash and debris; however, he has not taken measures to mitigate or remove the chemical residues remaining in or on the vehicle from the prior load. Likewise, the trucking companies' load finders typically are not trained to understand the issues of cross-contamination and the risks to foods associated with incompatibility between loads.

The risks associated with LTL shipments are a fact of life for the food processing industry. Moreover, due to economic considerations, there appears to be a trend toward expanding this practice. The delivery of foods from warehouses and distribution centers to the retail trade is done today almost exclusively on an LTL basis. In response to this food safety issue, a number of food processors and trucking companies have aggressively sought to implement transportation food safety programs. Such programs are intended to minimize the risk of cross-contamination during transportation. In general, the food processing company will work with its trucking companies to first identify compatible products and to prescribe the cleaning and sanitation measures that are required between shipments.

The key elements of a recommended transportation food safety program are: (1) a product compatibility matrix (Table 1); (2) a system for hazard classification; and (3) preventive measures. The program also must include provisions for verifying that the program is being executed according to plan. An additional necessary element of the program is training for drivers, load finders, logistics staff and quality and food safety personnel involved with food transportation. Using this three-pronged system, one can see in the abbreviated examples highlighted below that the emphasis is on preventing cross-contamination associated with the practice commonly referred to as backhauling.

At IPSC, we have constructed a product handling and compatibility matrix that shows types of food products (e.g., frozen meat, dry goods, fresh produce) as both outbound and backhauled items. Included in the matrix are hazard classification categories, ranked from those scenarios with the highest risk of cross-contamination (Category 1 Hazard) to those with the lowest risk (Category 4 Hazard). After the food processor has consulted the matrix and determined a system of hazard classification, he can then consult the definitions of the appropriate haz-

ard categories and make a sound decision about effective preventive measures.

For example, if the first shipment contained in a truck includes industrial equipment, botanicals or chemicals and the product being backhauled is fresh produce, the matrix shows the processor that this is a Category 1 Hazard: Special Handling. The Category 1 Hazard classification is reserved for hazards associated with chemicals, industrial equipment, botanicals and other sensitive nonfood materials. Category 1 represents the greatest risk for product contamination due to chemical or biological agents. Because of the high degree of associated risk, great care and diligence must be exercised when selecting product combinations that are assigned the Category 1 hazard classification. The company's food safety transportation program manual will include a set of preventive measures that correspond to Category 1. For example, such preventive measures would include the following:

Preventive Measures (Category 1 Hazards). Perform detailed inspection of the trailer for evidence of chemical contamination. Look for oily fluids, white powders, off-odors or other chemicals residues. If residues are found, consult the manifest and contact shipper of the previous load for assistance in identifying the compound and its source. Review the appropriate Material Safety Data Sheets (MSDS). Remove and dispose of compound according to the requirements of the MSDS. Ventilate the trailer with doors open fully and notify management of a Category 1 hazard. Hold trailer for disposition.

If no residues or odors are found, sweep, clean, hot-water wash and sanitize floors and walls. Air dry completely.

At the other end of the hazard spectrum, the food company consults the matrix and assigns a Category 4: Normal Handling classification to its practice of shipping paper products on the outbound delivery and backhauling fresh, raw meat. The Category 4 classification applies when the risk to the product is considered minimal. As a result, Category 4 Hazard preventive measures to be included in the food safety transportation program manual might read as the following:

Preventive Measures (Category 4 Hazards). Perform detailed inspection for abnormal situations or conditions. Remove debris and sweep floor area. Clean according to normal wash down procedures and schedules.

By way of further example, consider the scenario in which the load finder of a major carrier identifies an opportunity to backhaul a load of fresh produce. The load finder would first consult the manifest from the prior shipment and determine what material was last transported aboard the container. Next, she would consult the matrix to ascertain the risk of using the

container (as is) for holding and transporting fresh produce. For instance, the load finder determines that the previous shipment consisted of bulk pesticides (chemicals). Using the matrix, she would rapidly see that fresh produce is not compatible with the existing hygienic conditions (Category 1 Hazard) of that particular container.

It also must be stated that the major impediment to the successful implementation of such a program is the lack of available washout stations nationally. Most trucking companies operate cleaning and inspection gantries. The gantries are terminal-based and for exclusive use with company-owned trailers. The typical gantry has a hot water supply, cleaning chemicals, high-pressure cleaning units and the other requisite sanitation materials. However, public washout stations or gantries along U.S. roads and highways are virtually nonexistent. Consequently, if a company wanted to clean a container prior to taking on an incompatible shipment, it would be hard pressed to find a location that could accommodate its trailer.

Companies concerned with the risk of cross-contamination posed by LTL shipments have also developed and implemented similar strategies for purposes of countering this threat.

Oiling the Wheels of Change

The food industry has invested heavily during the past 20 years in improving the safety of its products. Segments of the industry have voluntarily embraced the Hazard Analysis and Critical Control Points (HACCP) approach to food safety. In the same period, the government has been very active in developing and implementing regulations intended to protect and preserve the public health status of the food supply, both at home and abroad. In 1990, due to concerns for contaminating the food supply during transportation, the U.S. Congress passed the Sanitary Food Transportation Act. This legislation, while seriously flawed, focused attention on the need for food safety transportation programs.

The events of Sept. 11, 2001, also pointed up the need to protect the food processing and food transportation infrastructures from groups, domestic or foreign, seeking to exploit vulnerabilities of these systems and cause harm to the American public. Again, the food industry and government have risen to the challenge. However, we must do more if we intend to realize a safe and secure food supply.

The food and transportation industries need to be aggressive in their efforts to root out the traditional causes of food safety failures associated with the transportation system. This effort will involve providing programs for improving the refrigeration capability of delivery vessels involved with cold chain handling and delivery of foods. Further, it is imperative, if food safety is to be preserved, that the food industry aggressively track and monitor the temperature of its products during transportation. QA/QC staff making judgments about the safety of refrigerated foods involved in temperature variance, in the absence of objective data, is a dangerous game.

Transportation food safety programs for containing the risk of cross-contamination are a laudable first step. Given the trend toward more LTL shipments, it is important that industry take a closer look at its food packaging systems and their role in preserving the public health status of the foods in the transportation system. Great strides have been taken to provide tamper-evident packaging for retail food items. Likewise, but to a lesser extent, the same is true for foodservice products. However, shipments of bulk products remain at risk and measures generally have not been taken to provide these shipments or their shipping conveyance with tamper-evident technologies.

America has the safest, most abundant and inexpensive food supply in the world. The U.S. food processing industry is clear-

ly the world's leader in terms productivity and the quality of its products. The regulations promulgated and enforced by the U.S. government are frequently adopted outright and used by countries around the world in providing a legal and scientific basis for promoting food safety. Nonetheless, the regulatory community, the processing community and the transportation community need to do a better job of protecting the safety and security of the nation's food supply. 

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