

Character Check ...

Do Your Meat, Poultry and
Seafood Have Integrity?

Quite often in the retail food industry, you'll hear the phrase, "product integrity", thrown around. Ask ten different people what the phrase means, and you'll get a number of different responses, each offering a nuance or two to add to, and further characterize, the overall definition. In a world of heightened awareness to foodborne illness issues, there are those that automatically and immediately equate "product integrity" with "food safety" in their minds¹. And while the safety of the food is indeed an important element of product integrity, by far, it's not the whole story.

A quick look in the dictionary and you'll see that the word, integrity, means "wholeness, completeness, soundness". When used in conjunction with retail food products, particularly perishable foods, there's only one assessment of the wholeness, completeness and soundness of a product that matters — that of the customer. Products with integrity perform superbly, provide good value, and satisfy customers' expectations in every regard, including subjective measures created by the usage of four of the five customer's senses — sight, taste, touch, and smell. And since it is those senses that drive a customer's perception and thereby opinion, it's fair to say that product integrity is really a combination of two things: things that the customer cannot determine on their own, and as such, must assume that those expectations are met (e.g., the safety of the food); and things that the customer can determine on their own utilizing their sensory experience (e.g., taste, touch, smell, appearance) to observe and form their conclusions about the integrity of that product.

¹ Establishing Food Integrity, Markus Lipp, 2014

Well, if that's the bigger picture of what product integrity means to a customer, the next logical question is what a food retailer can do to present the highest level of product integrity to their customers such that it becomes a source of sustainable competitive advantage. Recent research work² data, fully accepted and published in the journal *Food Control*, sheds some light on one very important part of the answer — the refrigerated display case technology employed to “present” the products to the customer. The objectives of this study were:

1. to determine the effect of refrigerated display case type on the shelf life and microbial load of beefsteak and chicken breasts and;
2. to evaluate the effect of a Complete Conduction Cooling Case (CCGA) vs. a Gravity Coil Service Case with Partial Conduction Coil Base Deck (PCC) on microbial growth (bacteria)

Let's look at perishable foods, like the beef steaks and chicken breasts used in the Iowa State University *Food Control* study, and consider how a customer defines “wholeness, completeness, and soundness” of those products. Aside from those things like food safety where the customer has little choice but to trust in the retailer, the customer's perception of the product's integrity is driven by what their senses tell them. They are determining product integrity by assessing such things as:

² Food Control: Evaluation of Shelf Life and Quality of Beef Steaks and Chicken Breasts in Refrigerated Display Cases Using Four Unique Cooling Technologies; completed by the Polymer and Food Protection Consortium at Iowa State University, 2018

1. How does the meat look? Is it the color of “freshness”?
2. How does the meat taste? Is it juicy and does it have superior flavor?
3. How does the meat smell? Does it have a pleasant aroma of freshness?
4. How does the meat feel? Is it tender? Proper texture?

Although these determinations made by the customer are subjective in nature (e.g., their opinion), there are very well-defined and measurable scientific explanations for the results. For example, the aroma of the meat is significantly determined by the type and degree of microorganism growth on the surface of the meat³; texture, tenderness and flavor are driven by the moisture content in the meat; and coloration can be a function of packaging, microorganism growth and product lighting.

In the case of perishable meats, it becomes obvious rather quickly that the refrigerated display case used is “the elephant in the room”. Not all display cases were born equal when it comes to the ability of their design technology to provide optimal conditions for storing and displaying their products. The case’s ability to control product tissue temperature and moisture content, microbial growth, shelf life, coloration and other aspects dictate the resulting customer’s perception of the product’s integrity based on the observations they make with their physical senses.

So, what did the *Food Control* study find when it comes to selecting the best refrigerated display case technology for favorably presenting a beef steak or chicken breast product’s integrity? Researchers studied four such full-service

³ Bacterial Contaminants of Poultry Meat: Sources, Species, and Dynamics; Rouger, Tresse, Zagorec; 2017

display case technologies and their impact on the product integrity and safety of merchandised beef steaks and chicken breasts. The primary difference between the four selected technologies was the way each was designed to “make cold”, either by employing means of convection, conduction, or a hybrid of both.

Specifically, the four case technologies were:

1. Conduction Cooling Gravity Assist Service Case (CCGA)
2. Gravity Coil Service Case with Partial Conduction Coil Base Deck (PCC)
3. Gravity Coil Service Case with Serpentine Assist (GSA)
4. Blower Coil Service Case with an Additional Fogging System (BCF)

Traditionally, retail food stores have used display cases that cool their products by using convection cooling to circulate chilled air over the product. An example of that would be the Blower Coil Service Case with an Additional Fogging System (BCF) used in the ISU study. Convection cooling is achieved either by using fans to circulate the cooled air (forced convection) or relying on the natural tendency of cold air to sink and warm air to rise (gravity-cooled), or a combination of both.

The alternative to convection cooling is conduction cooling, an approach that has steadily been gaining in popularity over recent years. Conduction cooling chills the product through the direct physical contact of two surfaces at different temperatures where heat flows from the warmer surface (product) to the cooler surface (deck pans) until they are equal. In a display case using conduction to create its cooling, the bottom of the display area consists of a special type of deck pans through which a chilled fluid flows to cool them to a desired temperature. When product is placed on the deck pans, it is conductively-cooled to the desired temperature by its contact with the deck pans and the subsequent transfer of heat.

The Conduction Cooling Gravity Assist Service Case (CCGA) used in the *Food Control* study offered further technological innovation in the form of pulse-flow control of the glycol refrigerant supplied to the deck pans and heat exchanger (at the top of the case and used to maintain case air temperature). The flow of coolant through these elements is constantly cycled between a low setpoint of 29 °F (coolant is shut off) and a high setpoint of 33 °F (coolant flows). Besides the effective and efficient temperature control of the microclimate³ created at the product surface by this technology, an even greater benefit is derived from the effect it has on tiny amounts of moisture in the air surrounding the deck pans that alternately freezes and thaws because of the coolant's pulse-flow control. This constant freezing and thawing of the minute amounts of moisture creates a high humidity area immediately surrounding the deck pans and any product situated on them, thus minimizing product shrinkage due to moisture loss. Likewise, the heat exchanger at the top of the case exhibits the same mechanism from the coolant cycling which results in helping keep the case ambient humidity at optimum levels. In traditional convection-cooled type cases, a common way to reduce the loss of moisture is through the use of misting (fogging) systems which carry the inherent potential for increased bacterial growth issues.

The *Food Control* study validated the fact that the Conduction Cooling Gravity Assist Service Case (CCGA) utilizing pulse-flow control, through its creation

³ The Free Dictionary, 2018

of a microclimate controlling temperature and relative humidity at the product surface, was superior to the other three technologies studied in its ability to create a favorable climate for the product integrity and safety of meat and poultry products.

So, let's connect some specific findings of the study with how they would impact and formulate a customer's perception of the product integrity of the displayed beef steaks and chicken breasts in a CCGA case. First, the conductively-cooled CCGA case exhibited the lowest product shrink of the four technologies evaluated due to its ability to keep relative humidity at properly elevated levels at the surface of the meat (microclimate) and thereby minimize decreased product weight due to moisture losses. This can be best shown by comparing the CCGA case's results with its next closest competitor, the Gravity Coil Service Case with Partial Conduction Coil Base Deck (PCC). By day 8 of the study, steaks held in the PCC case had lost 10.8% of their weight compared to 9.7% for steaks held in the CCGA case. Steaks lost more weight each day they were held in the PCC case than the CCGA case except on day 8, where steaks in both cases lost the same amount of weight. Weight loss from meat is an important economic factor because meat is sold by weight. The larger weight loss for steaks in the PCC display case is attributed to a lower relative humidity resulting from a more rapid circulation of air within the display case. These results agree with overall relative humidity measurement data taken daily in the four display cases where the lowest RH consistently tended to occur in the PCC case. What this reduced product shrinkage means to the customer who chooses to purchase this product displayed in the CCGA case is a tender, juicy cut of meat with superior flavor — surely the

kind of thing that serves to enhance the customer's view of the product's integrity.

The *Food Control* study also uncovered an important difference in the ability of each refrigerated display case technology to best cool the meat product. This is significant in terms of both product integrity and food safety.

The beef steaks placed in the four different refrigerated display cases were observed over an 8-day time period while the chicken breasts were evaluated over a 5-day interval. Looking at the specifics of the study results, the coldest product tissue temperatures were observed for steaks and chicken breasts placed in the CCGA (Conduction Cooling Gravity Assist Service Case) display case while the warmest tissue temperatures tended to occur when the cuts were placed in the PCC (Gravity Coil Service Case with Partial Conduction Coil Base Deck) case. The CCGA case had 2.95 °F (1.64 °C) cooler product tissue temperature than the PCC case. Putting this in perspective, although the number may not seem eye-popping at first sight, an approximately 3 °F differential in meat product temperature is very significant when it comes to pathogen modeling (growth of foodborne bacteria that can cause illness)⁴. What this means is that besides the shelf life advantage this would provide the food retailer by keeping the meat fresh longer, the CCGA conduction cooling display case offers the customer a higher level of product integrity, as evidenced by their senses of taste, sight and smell.

The growth of bacteria on the surface of the meat product is driven in most part by temperature and relative humidity and is responsible for discoloration of the meat as well as the introduction of foul odor ("rancidity"). The *Food Control* study

⁴ Pathogen Modeling, University of Wisconsin, 2009

demonstrates the CCGA case's superior results in maintaining proper RH at the product's surface while keeping product tissue temperatures lower throughout the meat's volume, thereby inhibiting these potentially product integrity-killing problems.

In conclusion, if the product integrity of your meat, poultry and seafood offerings is your focus, the results of the *Food Control* study suggest you take a hard look at the benefits that a refrigerated display case with conduction cooling and pulse-flow control technology like the Conduction Cooling Gravity Assist Service Case (CCGA) affords you. Your customer will notice the difference — a better-looking product with tender, juicy cuts of meat and superior flavor — quite the ticket for customers looking for product integrity!

So, do a character check — better yet, ask your customers — do your store's meat, poultry and seafood products have integrity?