

The Artful Science of Hot and Cold Holding

By Kimberly J. Decker, Contributing Editor

They say that good things come to those who wait and, most of the time, they're right. But when the "good thing" you're waiting for is an order of linguine with clams that's been languishing under a heat lamp while the kitchen works through its backlog, the wait might not be worth it.

Yet it's a fact of life that food sometimes will have to cool its heels a bit before it reaches the table. Some foodservice operations maintain a core of continual hot holding, whether in steam tables or under heat lamps. And heat isn't the only culprit of degradation in this game. Foods held under refrigeration can also face considerable challenges through their typically short shelf lives.

What's *not* a fact of life, however, is that this hot and cold holding should unduly deteriorate the quality of the food.

With a little strategic thinking, maintaining—and even improving—the holding quality of foods are orders that any foodservice or retail product manufacturer can fill. "It's really just a matter of planning ahead and using common sense coupled with your food-safety knowledge," says Jim (J. D.) Pintner, CRC, consulting chef, Sandridge Food Corporation, Medina, OH.

SAFETY FIRST

"Any food has the potential to carry with it a foodborne pathogen, albeit at low levels," says Martin Mitchell, technical director, Refrigerated Foods Association, Atlanta, and managing director, Certified Laboratories, Inc., Plainview, NY. That translates into meticulous temperature control, the best defense against pathogen growth—below 40°F for cold foods and above 140°F for hot, he notes.

Temperature control is all the more critical when you consider the opportunities for pathogen growth along the supply chain. In the case of foods manufactured or prepared off-site, manufacturers act to keep pathogens out of the product from the start, building hurdles into their products to slow the growth rate, sometimes to zero. Among these are adjustments of pH and water activity achieved through formulation, as well as the use of preservatives, including "natural preservatives like nisin and things of that nature that are approved and accepted," Mitchell says. Designing a food for optimum safety thus involves a "holistic approach," as he calls it, that accounts for the distribution, storage, shelf life and handling tolerances the product will need.

"You should design a facility and process that you and experts in the field believe is appropriate," says Mitchell, "and then you need to validate that that process is working and periodically verify that it's still in place." That means regular micro testing. He recommends working with an outside laboratory that can "swab and inspect the facility to verify that all the procedures are being followed."

MEASURING UP

As important as food safety is, consumers only notice when it's absent. Far more apparent is the sensory quality—aspects that can prove frustratingly subjective. “Holding quality can mean shelf life in an unopened retail container,” Pintner says, “or, for foodservice, can refer to how well a dish holds up between the time it's prepared and the time it's eaten. Maximizing the period of peak flavor and texture is what holding quality is all about. Freshness, uncompromised safety, food that feels good in the mouth, and superior taste and appearance are paramount.”

Running sensory testing on products at targeted points throughout their shelf life is always advised. “Since flavor and appearance are subjective, we taste-test products and answer questions on paper regarding how it looks and tastes,” says Pintner. “When appropriate, a fresh product is used as a control sample for comparison to the test product, and we hold a product exposed as it would be in a kitchen, either hot or cold, and test every hour.”

Such approaches are common throughout the industry to ensure product degradation is minimized across target holding times. “We measure holding quality through sensory panels, comparing samples at 5 minutes hold time, 1 hour hold time, 2 hours hold time, 3 hours time, and 4 hours hold time,” says Mark Graham, corporate executive chef, Basic American Foods, Walnut Creek, CA. “In the sensory panel results, we watch for a decrease in hedonic attribute acceptance scores. We judge the following attributes: appearance, aroma, overall flavor, texture and aftertaste.”

GETTING STEAMED

When properly tended, steam tables are a largely benign force. But they're not without their perils. “Food ingredients can get mushy, overcooked, caramelized, discolored, bitter and sometimes too wet or too dry, depending on the steam table setup,” Pintner says.

Mashed potatoes, for example, are liable to dry out when held uncovered. “The edges of the steam table are most affected by the heat and drying,” Graham says. Roasted potatoes can hold in steam tables for 2 to 3 hours “if surface crispness is not required,” he adds, while fried potatoes lose their surface crispness more rapidly, making them perhaps the hardest style to hold. “They're so much less forgiving,” he says. “Once you lose that crunch, it's gone. The window for that texture is very narrow, although there have been advances in food science that have helped considerably over the years. The coatings one sees on some french fries are a good example of that.”

Steam tables' main drawback lies in their imprecision, notes Karen Bishop-Carbone, director of quality assurance, Kettle Cuisine, Chelsea, MA. “There is a risk of overheating and excessive moisture loss,” she says. “Many steam tables don't have precise temperature indicators; they just have knobs with a number scale, and it takes some practice to get the adjustment right.” In the case of soups, one steam table unit may house several different varieties—cream-based, broth-based, vegetable, pasta—and she says the one-temperature-fits-all system fails to account for different viscosities and densities in each.

Far better are individual soup kettles, although even those are subject to foreign objects, ladle contamination and suboptimum temperature control. “Soup kettles need to be temperature-tested at least once a week to be sure they're calibrated properly,” says Pintner.

According to Bishop-Carbone, soup's ideal eating temperature is between 150°F and 160°F. However, "if you go over 170°F for too long," she says, "the starches and creams break down and will negatively affect both taste and appearance. It's also important to achieve the holding temperature fairly quickly—within 30 to 45 minutes. If heating is too slow, it will compromise quality and safety."

Bishop-Carbone limits the reasonable lifespan for a soup to a single meal period—four hours, tops. "When operators hold the soup for too long, it begins to thicken more than the product originally was," she says. "So, oftentimes, they add water to it, and when they add water to it, they dilute what the original flavor component was supposed to be."

Equally important are moisture conditions. Consider mashed potatoes. "Too much moisture, and they become soggy; too little, they become too stiff," says Graham. He recommends holding mashed potatoes covered; in the event they do dry out, just stir in a little boiling water "to refresh them to the original state." As for roasted and fried potatoes, the less moisture they pick up the better. That's not always an easy balance to strike. "The moisture from inside a fried food is tricky to control and can ruin the crispy texture we love on the outside," he says.

Graham recommends a maximum 2-hour holding time for mashed potatoes. "Highly flavored mashed potatoes may be held for 3 hours," he notes. And while some operations try to eke out 4 hours, "this is not recommended due to the development of off flavors." Roasted potatoes will hold in steam tables and hot cabinets for two to three hours; standard fried potatoes under heat lamps for 10 to 15 minutes (potato chips for hours or even days); and hash browns no more than half an hour.

Pasta has an ambivalent relationship with moisture, needing enough to gelatinize its starches, but not so much that it subsides into mushiness. "It's all about balance," says Jason R. Gronlund, executive chef, senior director of culinary, Carla's Pasta, South Windsor, CT. "There's a point where everything balances at the same moisture, because the pasta has wicked it until it can't wick anymore." When pasta starts wicking moisture from a sauce, though, both pasta and sauce suffer. "If I have a tomato sauce and the pasta wicks the water out of it," he explains, "the tomato acids get more concentrated, the sugar and salt get more concentrated, and now I have mushy pasta and over-acidic, salty sauce."

Moisture is actually a boon to meat, poultry and seafood items, explaining why sauces offer some protection against drying out.

COLD CASE

Refrigerated cold cases present yet another set of challenges. "Foods can get dehydrated, discolored and contaminated when held in open cold cases, because there is a lot of in-and-out traffic: moving and removing, touching, bumping," Pintner says. "All along the way, that compromises the cold chain and introduces bacteria." Dehydration and discoloration plague prepared salads in particular. "A refrigeration unit is, in a sense, a really strong dehumidifier," he says, "so most salads will benefit from being re-tossed occasionally to prevent drying and discoloration on top."

Pintner adds that salads with mustard in the dressing—for natural color, as well as flavor—may fade as a result of photo-oxidation, sometimes with the side effect of metallic off notes. "In grab-and-go cases, pre-packed salads are more sensitive to photo-oxidation because of how long they are there and how close they are to the bright light," he says.

Bishop-Carbone brings the conversation back to temperature control. "Most refrigerated cases are open to the air, which makes temperature regulation during storage and distribution difficult," she says. "But as long as products are kept consistently under 40°F, they'll be fine."

Pintner advises keeping salads covered and the cold case closed during the slower times of the day. "Monitoring temperature constantly and cleaning the inside and coils on a regular basis can also help keep cold cases in proper working condition," he notes. For sandwiches, building to order is ideal, but when that's impractical, he suggests displaying only enough to meet demand for half an hour, and keeping that covered or wrapped. "Most grab-and-go cases with individually wrapped sandwiches and wraps are fine when kept between 35°F and 38°F," he adds. "The other key is obvious, and that's to start with the freshest, highest-quality ingredients for your sandwich."

SECRET INGREDIENTS

Sometimes products destined for hot and cold holding can use a little help from industrial ingredients.

"There are a variety of conditions in which an application may lose desired characteristics while being held prior to service," says Joshua Brooks, vice president, sales and marketing, Gum Technology Corporation, Tucson, AZ. "The good news is that these problems can be solved by incorporating an appropriate gum stabilizer or gum-and-starch system."

Very small amounts of carrageenan, agar or konjac, noted Brooks, establish a structure in pasta that withstands softening on steam tables and holds texture better until service; in sauces or marinades, combinations of xanthan and tara gum prevent oil separation and suspend spices. "In baked goods," he continues, "we know that drying or staling can be an issue, and that gums in the galactomannan family, such as tara, locust bean and guar, either separately or together with xanthan, can delay retrogradation of the amylase in such products as they sit in cold cases or in the open in a holding situation." And a starch-gum "synergy" in cheese sauces stabilizes proteins and prevents their denaturation, ultimately making for a smooth, creamy mouthfeel in the finished sauce, he says.

As for flavors, it's common kitchen wisdom that they can improve with time. "The flavors and spices may actually increase because of the evaporation of water," says Michael Napoleon, product development research chef, David Michael & Co., Philadelphia. Nevertheless, he concedes, "protecting the flavors from the elements is always a smart way to get the highest-quality performance." For example, "hiding" a flavor in the pre-dust for a battered and breaded food, as opposed to mixing it into the breading itself, can preserve flavor by shielding it from contact with oil. "Another way to protect the flavor would be to encapsulate it in some type of barrier that is only broken by maceration or by temperature," he says.

In sauces and other high-fat items held on steam tables, Napoleon suggests using encapsulated or oil-soluble flavors. In applications held under heat lamps, moisture maintenance is the best bet for precluding off-flavor formation.

TEACHABLE MOMENTS

Experts can't emphasize enough the role that well-trained personnel play in optimizing holding quality. "Experienced and motivated employees are necessary in the deli or buffet setting," Pintner says. "Maintaining the appearance of foods so they look appealing isn't easy and takes constant attention."

Kurkjian agrees. "We lean very heavily on operator education to make this all come together at their site," he says. They encourage ample lighting of soup stations to enhance visual appeal; employees learn to stir the soups regularly and gently to distribute particulates, blend in oils that rise to the top, and even out the heating.

"When you're buying a fully prepared item, you ought to treat it with the same level of respect as you treat the things you prepare from scratch," says Kurkjian. "If you employ that general principle, everything else will fall into place."

Kimberly J. Decker, a California-based technical writer, has a B.S. in consumer food science with a minor in English from the University of California, Davis. She lives in the San Francisco Bay Area, where she enjoys eating and writing about food. You can reach her at kim@decker.net.

Giving Retail an Edge Through Packaging

Supermarket prepared-food departments are enjoying a renaissance that puts them in serious competition with restaurants. According to the July 2010 Packaged Facts report "Prepared Foods and Ready-to-Eat Foods at Retail: The New Competition to Foodservice," 64% of adult consumers surveyed purchased ready-to-eat/heat-and-eat foods from a grocery store or supermarket in the last month. Moreover, patronage of supermarket prepared-food departments tops both family and casual restaurant segments in total usage, trailing only fast food and QSR.

While this is encouraging news for retailers, it also ups the ante for the level of quality they have to deliver to keep erstwhile restaurant diners coming back for seconds. As Sean Brady, North America technical development manager for ready meals, Sealed Air/Cryovac Food Packaging Corporation, Duncan, SC, says, "Restaurant quality is what people are expecting."

Yet as retailers try to capture the audience migrating from restaurants to cold cases and deli counters, they often find their back-of-the-house setups ill-equipped to execute all the operations they hope to accomplish efficiently. "It's a skill-set issue. It's management of all the meal parts: the proteins, the starches and the produce. They have a lot of food waste and items that don't get used before the product goes bad," Brady says. "Trying to pull all that together in the back of the store and still offer a lot of SKUs is very complicated to do safely."

As a result, retailers are leaning on central commissaries as well as their suppliers to do the heavy lifting of advance prep for them. "They're trying to get the foods or food components delivered instead of doing as much in the back of the store," says Brady. "That way, they can control the process and the food quality a little better."

The introduction of "smart" packaging is one way commissaries and suppliers can lock in that quality. In fact, Brady says, it's in supermarket kitchens "where a lot of the new packaging plays the biggest role in giving those items the attributes that they need."

Perhaps the most-important attribute is extended shelf life. "Some products for back-of-the-house will require anywhere from 10 to 50 days of shelf life as they go through distribution, preparation in a central kitchen, and being brought into the stores," Brady says. "Then the stores open the product as they need it to preserve the quality and safety, using only what they need without the spoilage that they would otherwise have."

Vacuum packaging for hot meals. "Most retailers use a tray-lid application with a modified atmosphere," Brady says. "However, we're starting to see some switch to a vacuum because of the shelf life versus a modified atmosphere." Meals packaged this way can go through a more-efficient secondary pressure or thermal treatment, he adds, and they have the added convenience for the end user of being dual-ovenable. "It has an easy-open top and it's self-venting," he notes, "so it has some steaming effects, too."

Next-generation ovenable packaging. According to Don Smith, director of marketing for poultry and seafood, North America, Sealed Air/Cryovac, his company is developing ovenable materials that can go straight into a 375°F oven for up to four hours. "The goal here is to have a vacuum package with a good oxygen barrier that gives you a good shelf life," he says. The end user "could place the packaged product in the oven and either cook it or reheat it." One advantage for foodservice is the holding time. "It will retain moisture and it's great at retaining heat even out of the oven," he says. "And it's got enough abuse resistance to handle distribution, frozen or fresh, without puncturing and still provide convenience."