



ENSURING FOOD SAFETY: KILL STEP AND VALIDATION IN PET FOOD BAKING

The pet food market is expanding rapidly, with baked products gaining traction for their unique attributes and consumer appeal. But with growth comes risk: poorly designed processes or inadequate validation can expose brands to food safety incidents with lasting reputational damage.

By Reading Bakery Systems

Growth of the Pet Food Market and Rising Safety Concerns

Growing pet ownership and greater nutritional awareness have fueled strong demand for commercial pet food in recent years. More consumers now prefer “complete and balanced” foods, prompting a wave of manufacturers entering this dynamic market. While product variety is at an all-time high, **the race for novelty sometimes overshadows food safety considerations.**

For example, raw diets, once regarded as the most “natural” choice, have faced heavy scrutiny following avian influenza outbreaks linked to pet deaths (Goodman, 2025). But contamination risks extend well beyond raw products.

A review of recalls from 2003-2022 found that up to 35% of pet food recalls were caused by biological contamination, most often *Salmonella* (DeBeer, J. et al., 2024). This presents a particular risk to young children and older adults exposed during handling (PetfoodIndustry, 2024).

Even baked products, which undergo high temperatures during the baking process, are not immune if processes are inconsistent. A single safety lapse can erase years of brand trust, underscoring the importance of robust food safety controls. This paper explores the design and validation practices required to ensure an effective kill step in baked pet foods.

Challenges in Achieving the Kill Step in Pet Food Baking

Baked kibble is valued as a healthier, “humanized” alternative to extruded products, yet ensuring every piece reaches a validated kill step is not guaranteed. Common risks include:

- **Cold or dead spots in ovens:** Inconsistent airflow or temperature distribution can leave small kibble (5-6 mm) under-processed. Extending bake times to compensate often results in over-browning or burnt products.



Figure 1: Customer expectation of consistently baked kibble.

- **Excessive product piling:** Loading too much product onto the belt impedes heat penetration into the inner layers as the kibble piles up, especially in single-pass systems where the oven is the bottleneck in line throughput.
- **Post-baking contamination:** Poor line layout or hard-to-sanitize conveyors can re-introduce pathogens after baking.

These risks highlight why oven design and process validation are critical for consistently achieving a verifiable kill step.

The RBS Approach to Safe and Efficient Baking

RBS addresses these challenges with a two-stage baking and drying process designed for both safety and throughput.

Step 1: Baking

RBS convection ovens feature a centralized penthouse system with independently controlled top and bottom airflow delivered through perforated plenums (Figure 2). Operation is simple—operators only need to set the penthouse air temperature, balance the airflow, adjust the exhaust fan speed, and control bake time. This is all done on the control screen, and recipes can be stored for easy and repeatable production.

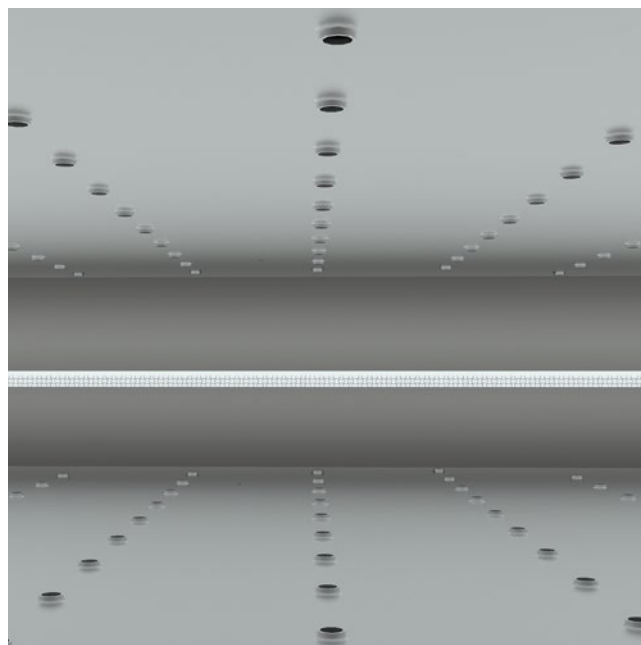


Figure 2: Top: RBS Convection Oven with centralized penthouse. Bottom: Perforated plenums for consistent airflow.

This oven design delivers uniform airflow and precise temperature control, ensuring consistently baked products every time. The oven functionality can be validated with the Scorpion® 2 Profiling System. The Oven Air Velocity Graph (Figure 3) generated using data collected by the Scorpion 2 shows different color lines to represent the sensors' position from the left side to the right side of the oven belt. Overlapping lines indicate that air velocity from the left to the right side of the oven belt is highly uniform. As the sensor travels along the tunnel oven from zone 1 to zone 5, velocities are largely uniform within each zone, where each peak represents the airflow surge from perforations on the plenum surface.

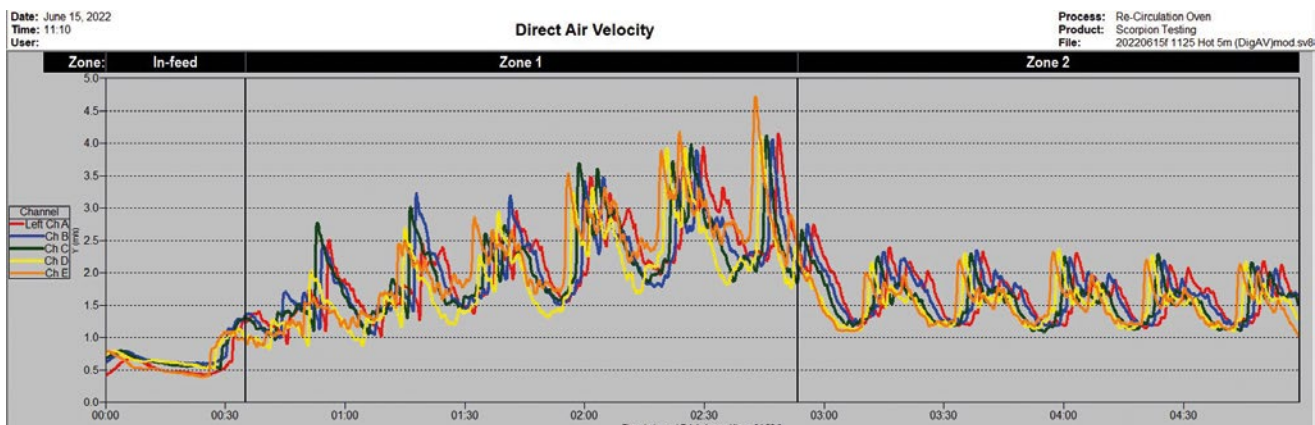


Figure 3: Scorpion 2 Air Velocity Graph.

Products are loaded in mono- or bi-layers, maximizing heat penetration and ensuring each piece receives sufficient heat. Over-stacking is avoided to prevent uneven baking between outer and inner layers. This high-temperature, short-time bake achieves the kill step while maintaining color uniformity and maximizing throughput (Figure 4).

Figure 4: Baked kibble entering the oven in one layer to ensure efficient baking.



Step 2: Drying

Once the kill step is reached, products move into a low-temperature, long-time drying phase to gently reduce residual moisture. Dryers use the same oven airflow design principles to maintain uniformity. Depending on space and capacity needs, customers may choose:

- Single-pass oven with separate 3-pass dryer, or
- 2-pass oven/kiln system that integrates baking (top pass) and drying (bottom pass) into one zone. This set-up allows for a smaller footprint.

This separation allows shorter bake times with mono/ bi-layer product loading for effective kill steps, followed by multi-layer drying (typically 4-5 product layers) for efficiency (Figure 5).

Figure 5: Multi-Pass Dryer for slower drying to gently reduce residual moisture.



Validating the Kill Step

Kill Step Validation requires direct measurement of the product’s internal temperature during baking. The Reading Thermal Scorpion 2 Data Logger uses temperature probes for measurement of product internal temperature during the baking process (Figure 6). By combining this data with specific thermal tolerance coefficients (T_{ref} , D_{ref} , z), lethality can be calculated using the Kill Step Calculator developed by AIB International, in cooperation with Kansas State University, the American Bakers Association (ABA), and the University of Georgia, to determine if kill step is complete (Kill Step Calculator | Bakery Process | BAKERpedia, 2016). Our SV8 software can then be used to generate the kill step report. Bake time and baking temperature can be further optimized by analyzing the lethality curve generated by SV8 software.



Figure 6: Top: Product probes for measuring internal product temperature. Bottom: Scorpion 2 R&D Kit with product probes.

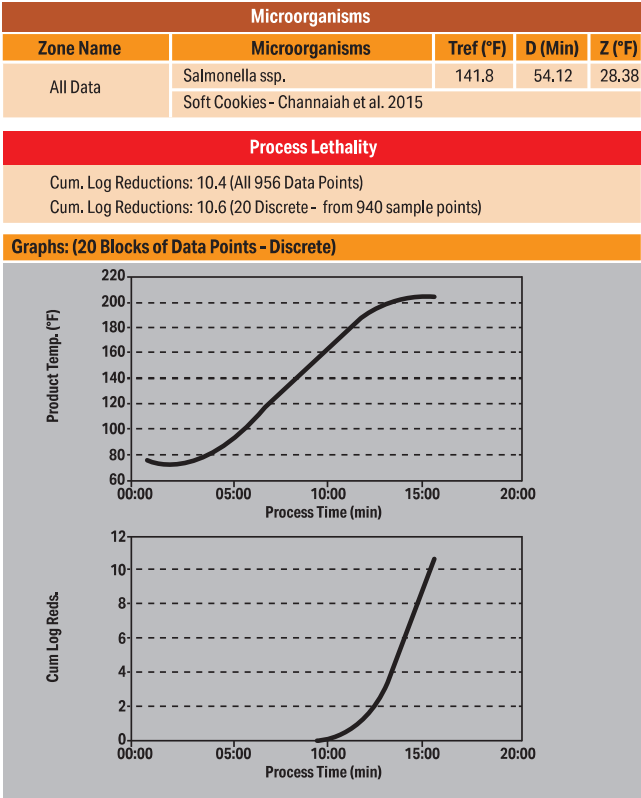


Figure 7: Internal temperature vs time and cumulative lethality vs time graphs as part of kill step report generated by SV8 software.

Beyond kill step validation, the Scorpion 2 can be equipped with air velocity, temperature, humidity, and heat flux sensors to better understand oven performance. The air velocity sensor and air temperature sensor arrays can be used to validate the convection oven design to ensure that air flow and temperature distribution is uniform both across and along the oven belt (Figure 8).

Conclusion

RBS mitigates these risks with proven baking and drying solutions, paired with the Scorpion® 2 profiling system, giving manufacturers confidence that every batch meets FDA FSMA kill step requirements. With RBS, you can achieve both safety and efficiency—ensuring your products earn consumer trust and stand out in a crowded market.

For more information, visit readingbakery.com or call +1 610-693-5816.

Figure 8: Temperature and air velocity sensor arrays for oven profiling – Temperature and airflow distribution data within tunnel ovens can be collected and displayed as 2D or 3D graphs in the SV8 software to identify color / hot spots in oven chamber.

