

Ease those Cook & Chill HACCP Headaches

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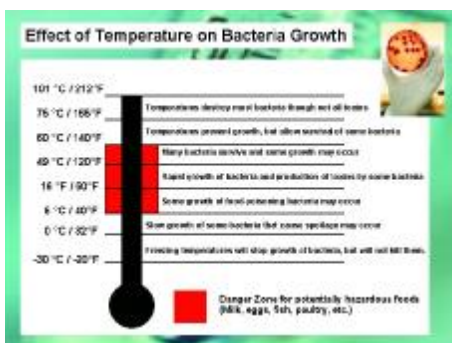
Why is Food Cooked?

For years cooking has been implemented to improve the quality of a vast array of food products. Food further processors world wide for this very reason increasingly supply ready cooked products to add value to the product and so maximise market appeal. Benefits of cooking are well documented to include improved flavour, palatability, texture, shelf life, reduced preparation time in the home. The overriding benefit, and critical requirement, in many food sectors, particularly meat and poultry, of cooking though still remains product safety. The domestic consumer when purchasing pre-cooked food from the supermarket or at a restaurant expects the food to be safe to eat. With increased public awareness there are increasingly more and more visible published food poisoning outbreaks being traced back to the offending food processor. The potential outcome of this action in terms of product recall, loss of customer confidence in a food brand or supplier and cost of litigation from affected individuals can be catastrophic to the profitability of a company and threaten its future market presence.



The HACCP principle

Faced with market and regulatory pressure to provide safe food products food companies worldwide are adopting HACCP "Hassip" either by choice or as a mandatory requirement. HACCP stands for Hazard Analysis and Critical Control Point, and involves the systematic assessment of all the main steps involved in a food operation and the identification of those steps, which are critical to the safety of the product. The HACCP protocol contains seven main principles, which are used to Identify Control Monitor and Document potential hazards in the food processing operation. For a poultry further processing operation often the most important critical control point within the HACCP protocol will be the cooking and chilling process itself. An example of typical HACCP protocol for a poultry cook process is shown in Table 1. As illustrated in Figure 1 potentially lethal bacteria such as Listeria Monocytogenes have a critical interdependency on temperature. Getting the cook & chill process wrong can be seen to not only lose any guaranteed safe kill of bacteria but actually create conditions where an existing contamination can be made significantly worse. There is often a fine dividing line between bacteria growth 120 °F and bacteria kill 158 °F.



HACCP		
Principle 1	Analyse Hazards	Listeria Monocytogenes
Principle 2	Identify Critical Control Points	Cook / Chill
Principle 3	Establish preventive measures with critical limits for each control point	Cook Temp = 65°C
Principle 4	Establish procedures to monitor the critical control points	Fast Cook Core Temp Fast Run / Cool Set Temp / Line Speed
Principle 5	Establish control systems to be in place when monitoring shows that a critical limit has not been met	Check and Control Cook Parameters, No-cook / Escape of Product
Principle 6	Establish procedures to verify that a system is working properly	Test and Calibrate Oven Controllers (Temperature & Line Speed)
Principle 7	Established Effective record keeping to document the HACCP system	90% & 60% insect traps

Figure 1: Schematic of the effect of Bacteria growth on environment temperature

Table 2: Example of a generic HACCP protocol overview for poultry further processing highlighting the Cook / Chill CCP

Implementing the HACCP plan in Practice

For many food processors HACCP protocols as detailed in Table 2 are commonly implemented. The main crux of the process is the manual testing of food product temperatures at the exit of an oven or during storage in a blast chiller with a hand held thermometer. This action in itself is easy to implement but does have some issues that must be managed with care.

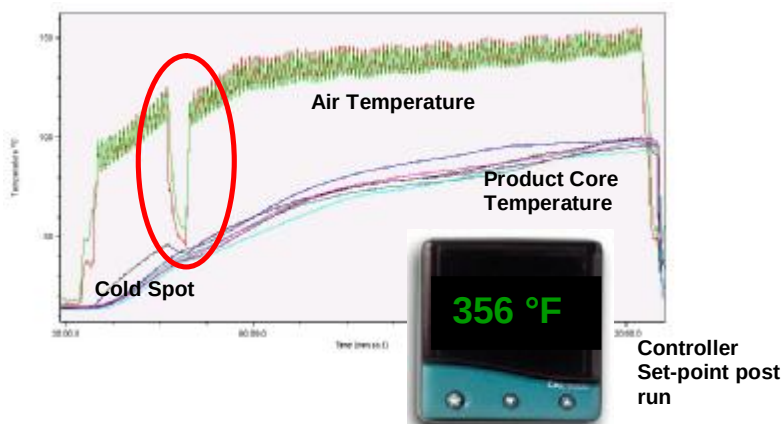
- (a) Does the exit temperature accurately reflect the peak product temperature?
- (b) Is the operator measuring the correct part of the product test to test?
 - Core or Surface
- (c) Is the operator measuring products over the entire cook / oven area
 - Top and bottom of a static food rack or left to right on a conveyor mesh belt
- (d) Is manual recording of product temperature readings truly certified and traceable due to the potential error of transposing readings from a digital display to QA test sheet?



From the list above it is safe to say that item (a) will in most cases ensure safe cook since the temperature of the product normally will peak in the oven before the QA operative can access the food for measurement purposes. From a productivity view though it may be more an issue that over specifying the QA test temperature may be unnecessarily compromising quality and yield.

The greatest deficiency of the use of a hand held thermometer is that they at best only provide a point measurement post process. If the product core temperature is greater than the specified safe minimum everything is fine and processing can continue with confidence. In the event of the core temperature being less than the target value though major problems need to be addressed and quickly. From Table 1 principle 5 outlines necessary corrective action for a failed core temperature as checking oven parameters (set point temperature and line speed) and rectifying. Obviously an undercooked product can result from the oven being run using the incorrect cook parameters (Too low Set point or too quick Line speed). What options though are left to the QA manager when he faces a situation where the product core temperature is too low yet the oven controller on inspection is correct for the cook procedure.

As most in production will have experienced the oven controller read out does not necessarily give the whole picture of what is happening in the oven. The oven temperature control sensor is often located away from the product and does not always reflect the temperature experienced by the product. The temperature experienced on a micro level by the product can be effected by many variables including air velocity and moisture level and be independent of the oven set point. Poorly balanced air flow within an oven can result in temperature imbalance within the oven resulting in significant different cook rates either over the height of a product rack in a static or rotating batch oven or across the mesh belt of a conveyorsised oven. On a simplistic level in a batch cook process the opening of an oven door mid cook may be totally missed by the oven controller unless some form of data archive is used. At the end of the cook cycle the product fails the Spot check yet when the QA manager checks the oven temperature set point everything appears to be fine.



As can be seen left in the only fail safe way to allow QA data that also can be used for corrective action is to measure the oven and product temperature profile through out the entire process using an oven monitoring system such as the Datapaq Food Tracker.

Food Tracker System

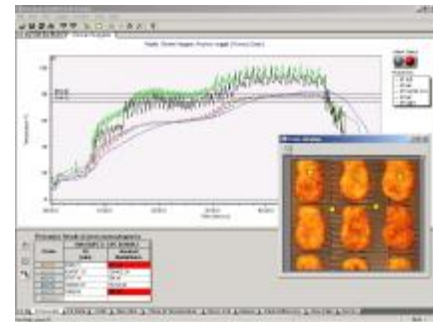
Temperature Profiling with Datapaq Food Tracker



Reset Logger
Probe Product
Place in Barrier



Send Through Oven Measure
Product and or oven
temperature



Retrieve Logger
Download data to PC
Review Profile and Analyse
CCPs.

The Datapaq Food Tracker system is a temperature data logging system designed to travel with the product through the cook chill process measuring the product and or oven temperature. The data logger measures product temperature via thermocouples (up to eight) that can be placed in a product or number of products located within the oven. Since the logger is removed from the sensing point of the thermocouple product temperature can be accurately measured without an thermal mass errors from the equipment and the probe can be placed exactly where the measurement is required (breast meat, muscle, skin or bone layer). The thermal barrier is employed to protect the data logger from the hostile environment of the process. Along with temperature protection the barrier protects from water and steam and systems are available that will even allow measurement through deep fat fryers.

After the process that temperature data collected from the system is transferred to a PC where the profile data can be reviewed in detail. Using customised calculations like peak temperature, time at temperature and lethality calculations (Fo) the Critical Control points of the cook and chill processes (Figures 2 & 3) can be verified accurately and quickly and then used to create documentary proof of HACCP compliance.

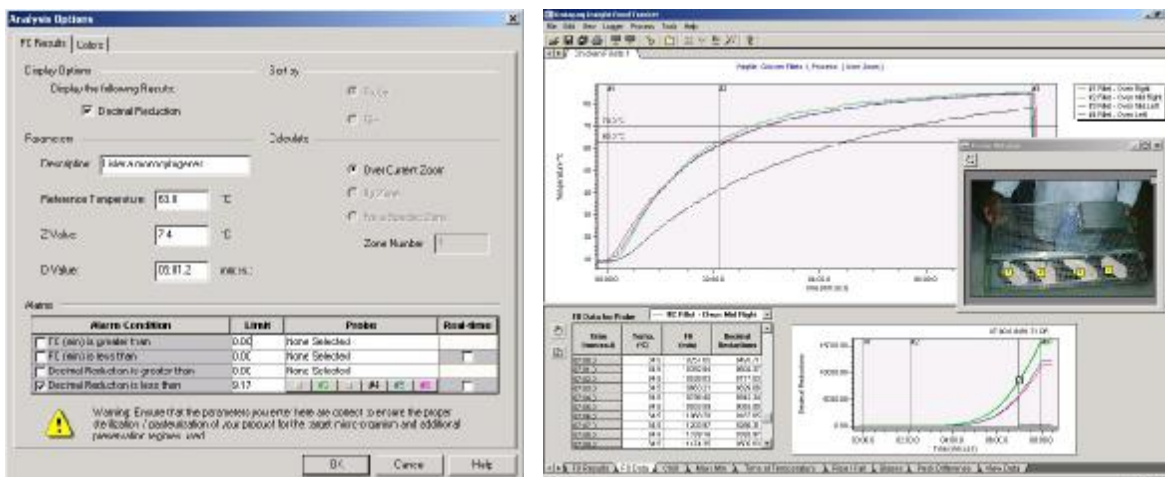


Figure2: Analysis of cook CCP using lethality calculations for kill of *Listeria Monocytogenes*. Using the entire profile data the software calculates the Fo value or number of decimal reductions in the bacteria population. From a single number you can instantaneously prove product safety. Applying alarms process problems are highlighted clearly and immediately.

Food Tracker System

Obviously the immediate benefit of applying temperature profiling as a means of your routine HACCP protocol is that you are able to measure the true CCP of the product. In the event of problems you also have all the process data to see where problems occurred and necessary data to correct and then verify success of corrective action. Measuring both process and product temperature allows easy process development and optimisation and process validation against the target CCP limits as part of the HACCP plan specification. For new product lines the profile system pays for itself simply by allowing quick accurate identification of what cook parameters are required to achieve the desired CCP targets.

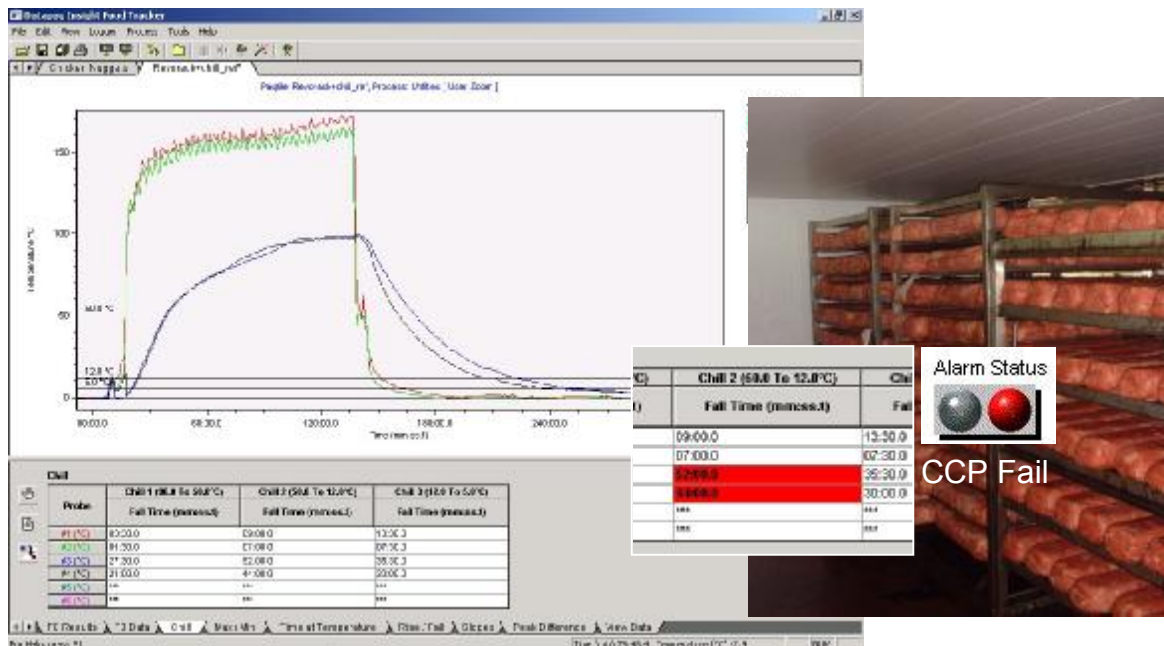


Figure 3: Chill CCP Analysis of Ham in blast chiller post cook as part of LACOTS (USDA) guidelines. Automatic analysis of fall times between specified target temperatures to ensure that microbiological growth post cook is prevented. Using alarms failed CCP limits are highlighted in Red allowing immediate corrective action strategies to be employed.

What Processes can be monitored?

The scope of applications that can be monitored by the Datapaq Food Tracker is comprehensive as illustrated in Table 2. Through careful selection of barrier and thermocouple the system can be customised to match the requirements of many batch and conveyorised processes.

Table 2: Food Tracker Process Capability

Baking	Steam Cook
Roasting	Pasteurization
Drying / Curing	Flash Frying
Blast / Spiral Chilling & Freezing	Nitrogen Freezing
Total Immersion Boiling	

Food Tracker System



Figure 4: Example Processes

Flash Frying- Thermal barrier provides full waterproofing to allow travel through a deep fat fryer fully submersed. 22 mins protection @ 392 °F submersed.

Batch Roasting – Barrier used in the roasting / blast chill of Duck portions. Barrier is shower and steam proof. 2.25 hours protection @ 392 °F



Impingement Freezer - Protection to system and allowing accurate data collection at environmental temperatures of -40 °F and even lower.



Fig 5: Thermocouple choice Selection of probes to match the product and process. Barbed needle probes provide easy accurate penetration into poultry flesh to the desired measurement location. Probe movement or removal from the product is prevented by the barb. This guarantees reliability and consistency of measurement.



Benefits without compromise on Safety

Implementing oven monitoring provides so much more to the processor than satisfying HACCP requirements. In the very competitive nature of processing and drive to increase productivity and yields, profiling gives the very data and information to get the most out of your process without compromising safety.

Food Quality – Optimise the process to maximise the quality of the food, with regard taste, texture and uniformity of colour. Prevent product recall on cosmetic grounds or batch to batch variation.

Profitability - Knowing that the product is safe optimise the cook (temperature and time) accurately rather than adding an over cook safety contingency. Decrease the cook temperature by 2 degrees Celsius or cook time by 10 % and benefit from resulting throughput and product yield per item.

Problem Solving – When process problems occur have the necessary data to help engineers first identify the fault and then rectify it quickly so limiting down time of the process line. Use the same profile information to prove the engineering fix has been successful allowing continued production.

Problem Prevention – From regular profile runs understand the operating variability of your process. Compare historical runs to potentially identify slow deterioration in performance allowing planned preventative maintenance rather than waiting for immanent catastrophic line failure.

Process Validation – Provide Certified and traceable profile reports (figure 6) to your customers as evidence of the product quality you provide and value added process control measures undertaken to guarantee that quality.

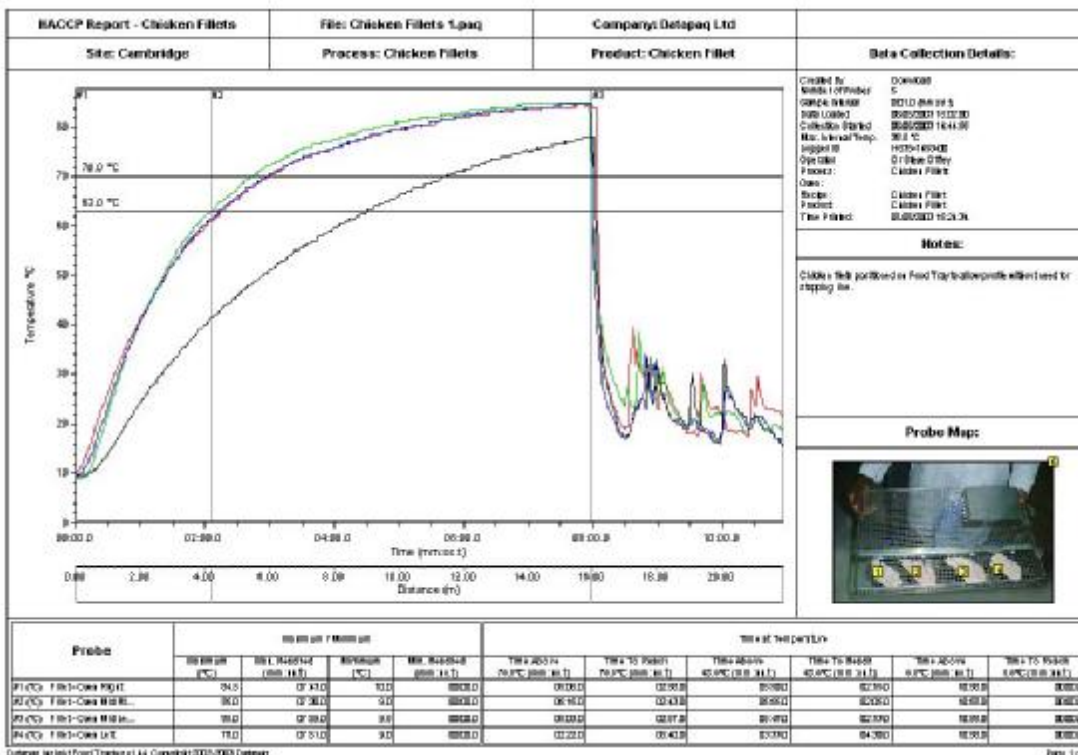


Figure 6: Oven Profile report used for CCP monitoring with all the necessary date stamps, file names and logger identification information needed to provide traceability and full certification.

Food Tracker System

Technology making HACCP easy and Efficient

Obviously any HACCP protocol needs to be made as easy to implement as possible to guarantee that it is maintained routinely. Recent advances in temperature profiling are helping in this respect.

Real Time RF Monitoring

One of the most effective technological advances is the availability of Real time monitoring of a process. The MultiPaq21 data logger can be equipped with a radio telemetry transmitter, which sends the recorded temperature data directly from the oven back to the PC. With this feature the exact product temperature can be identified at any point in the process live. Using such information obviously problems can be identified immediately and for batch type process the exact moment that a safe cook has been achieved unloading and reloading of an oven can be started minimising unnecessary over cook and maximising productivity.



Fig 7: (a) Food Tracker RF system installed on food rack showing external transmitter aerial which sends data straight back to the monitoring PC. (b) Data logger with RF aerial and receiver unit (c) Rotational batch roasting oven into which the product rack is wheeled. Transmission of temperature data, both product and air, from inside the oven is possible without any need for trailing thermocouples which would be impossible if any rack rotation is employed.

Food Tray Technology

Obviously the more regular a profile is performed on a processing line the more confident you are regarding the operational control. To help ease regular profiling the Food Tracker system is complimented by a Food Tray accessory.



Fig 8: Datapaq Food Tracker profile tray used for repeatable monitoring of conveyORIZED cook processes quickly and efficiently.

The aim of the tray is to allow the whole profiling system including product to be placed easily and efficiently onto a moving conveyor in one step. Product such as chicken nuggets are positioned onto the thermocouples permanently mounted on the tray. In this way the product being measured is held securely therefore limiting the risk of probes moving or pulling out of the product. The product position relative to the oven is also kept consistent run to run helping with process control activities. Removing any need to stop the line to place the profile equipment onto the mesh belt and position the product portions across it removes any lost production and so maximises the productivity of the line.

Conclusion

In summary it is proposed that the regular routine use of a Datapaq Food Tracker temperature profiling system is the only true procedure that can comprehensively satisfy all the principles of the HACCP protocol for Cook and or Chill processes.

The Food Tracker benefits over the use of hand held thermometers, to spot check product core temperatures post cook, in that as it provides a complete historic record of the product and or oven temperature during the process. This information is invaluable if the CCP target value is not attained since it will highlight problem areas in the cook such as cold spots causing the undercook. Profile data allowing quick accurate fault finding is also invaluable to verify that any maintenance action to correct the fault has been successful. Employing the Food Tracker a clear understanding of the effect of the ovens operating characteristics on the product cook profile can be established. This information helps significantly with product development and optimising the cook cycle to guarantee product quality, yield, and productivity without having to compromise on product safety. In short the Food Tracker temperature profiling system provides the means to maximise the profitability of your cook line and guarantee a quality product that will keep you and your customers happy.

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