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Application Note
FEB 2019

Pasteurization & Cook-Chill Processing Methods

EBRO FOOD APPLICATION NOTE

While commercial Food preservation in general has been known to serve the main purpose of slowing down the rate of food deterioration or spoilage and ensuring food safety, the quality and sensory attributes of the food product must also not be compromised.
With hundreds and thousands of different food brands available in the market, your product needs to be fresh, with just the desired texture, flavoursome and delectable when compared to other competing brands.
Therefore, tests and measurements in the whole process are necessary to optimize the food preservation process and provide the food product just the right 'microbial kill'.

Most of these measurements such as Heat Distribution Tests (HDT) and Heat Penetration Tests (HPT) in food processing are in Retorts where low-acid food products are made to become shelf-stable in hermetically-sealed containers.
The most popular retorted commercial products are still those products in cans and in pouches.

Retortable Pouches and Cans Processed in Retort Vessels

This has changed dramatically in recent years because of the consumers' desire for better-tasting, fresher and healthier food products and therefore requires these food products not to be treated with extremely high temperatures to addressing food safety.

This made the **Low-Acid Pasteurization Method and Cook-Chill Processing Method** one of the best options and at the same time the most economical yet effective processing alternative.

This process involves lower temperatures to effect microbial inactivation but requires continuous control to extend shelf life and keeping food safety as its main objective without compromising on quality, taste and other fresh-food goodness attributes.

However, as this process is the least to address the near-absolute destruction of microorganisms, it should therefore be a highly-controlled process that requires in-situ accurate measurements and a well-documented thermal process validation.

This means continuous measurements from cooking, packing, chilling, food storage and distribution in accordance to acceptable standards and guidelines such as SOPs, HACCP and other Food Safety guidelines.

"..This process involves lower temperature to effect microbial inactivation but requires continuous control to extend shelf life and keeping food safety as its main objective without comprising on quality.."

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Low-Acid Food Products

Aside from the conventional Sous-Vide or Cook-Chill processes utilized by the Foodservice industry, where foods are fully-cooked, vacuum-packed, blast-frozen and chilled so they can be served with a simple re-heating; other food products are even hardly-cooked such as heat-sensitive fruit beverages and heat-sensitive seafood products such as crab meat.

The photos above are Low-Acid Food products and the microorganism of concern will always be the most heat-resistant spore-forming clostridium botulinum and generally destroyed by a sterilization process at 121.0°C. But doing so will damage the quality attributes and sensory properties of the heat-sensitive food products.

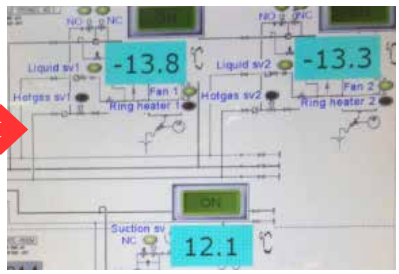
Cook-Chill Methods similarly with the other Pasteurization Methods will not allow 'cook' temperatures at more than 95.0°C.
Crab Meat for instance, considering its exquisite taste and naturally white colour, as much as possible must not be cooked over 90.0°C.

Following strict guidelines & codes of practice, for instance from the *Codex Alimentarius* for Pasteurized crab meat – the crab meat in their packaging (cans, plastic tubs, bottles) are pasteurized in the hot water tank with temperatures from 85.0°C - 88.0°C for about 120 minutes or so until the process is able to provide the products a Po-value of < 31.0mins then immediately cooled in a chilled tank until the product temperatures are lowered down to below 3.0°C.

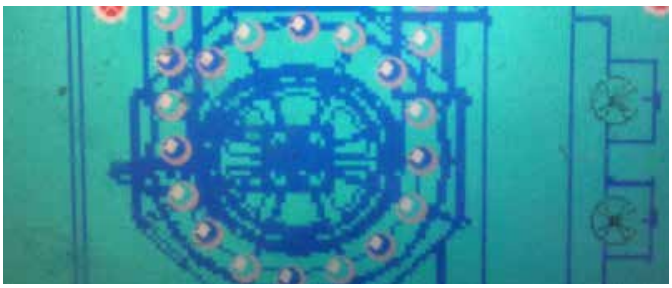
Crab Meat in Plastic Tubs

Hot Water Tank

Quick Chilling



Other food products that undergo cook-chill processing method are quickly loaded into a blast freezer before they are stored. An improved system is a spiral blast freezer unit for a better yield and consistent freezing condition:



Spiral Blast Freezer

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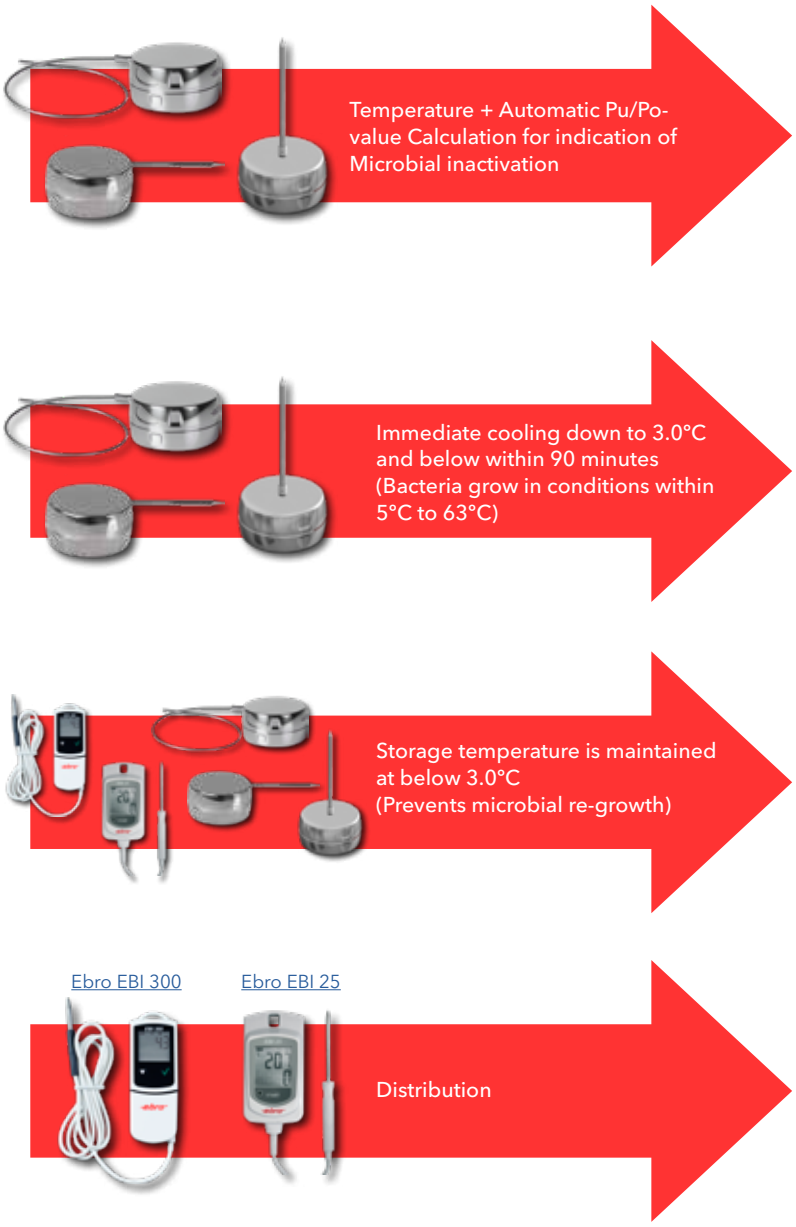
This application note focuses on the benefits of the Ebro EBI 12 Wireless Temperature Data Loggers in ensuring the adequacy of this processing method and to give us a good indication that those microorganisms that were *inactivated* by the process are not given any conditions for *re-growth*.

This is best illustrated as follows:



Cook Phase: Machinery / Equipment
- Kettle cooking
- Pasteurization bath
- Food service facility

Cook Phase: Product
- Food product in itself
- Food product in packaging

Chilling or Cooling Phase
Immediately after the Cook Phase:
- Chiller tank
- Blast freezer
- Blast chiller

Chiller Room or Cold Storage:
- Storage validation
- Product temperature documentation before distribution

Distribution:
- Refrigerated / temperature-controlled transport
- Product temperature documentation is a requirement

(Food Micro: Madigan et al. 2015. Brock Biology of Microorganisms. 4th ed. Pearson Education, Inc.)

The first two phases of this method of Pasteurization or Cook-Chill are considered the most critical where a required lethality value represented by P_u or P_o-values (sometimes C_o-values) as values of significance determined for each types of Food products must be achieved. *(Codex Guidelines and Codes of Practice)*

These required lethality values, in their least number, must be provided to the products by the process with examples as shown below:

(Book of Manfred Eisner; N.F.P.A, N.C.A., Raichert)

Lemon juice	2.5	0.1
Plums	2.9	0.2
Gooseberries	3.0	0.5
Pickled Vegetables	3.0	0.5
Greengages	3.2	0.8
Rhubarb	3.2	0.2-0.4
Mandarins	3.2-3.4	1.0-2.0
Grapefruit Juice	3.2	0.2-0.4
Apricots	3.2-3.4	1.0-8.0
Apples	3.3	0.2-0.6
Blackberries	3.3	0.2-0.6
Orange Juice	3.5-3.8	0.6-0.8

Pineapples	3.5	0.8
Strawberries	3.5-4.0	0.4
Jams	3.5	0.8
Sour Cherries	3.5	0.2-0.4
Sauerkraut	3.5-3.9	0.5
Pickled Gherkins	3.5-3.8	0.5-1.0
Bilberries	3.7	0.5
Sweet Cheeries	3.8	0.6-2.5
Guavas	3.8	0.8
Nectarines	4.0	1.5-8.0
Peaches	4.0	1.5-8.0
Pears	4.0	1.3-1.0

Herring in Tomatoe Sauce	
Herring in Oil	5.0-10.0
Sardines in Tomatoe Sauce	
Sardines in Oil	7.5
Salmon	
Tune Fish in Oil	
Mackerel in Tomatoe Sauce	5.0-14.0
Carp in Tomato Sauce (with bones)	28.0-30.0
Mussels (natural)	4.0
Shrimp in Brine	1.4-4.5
Fish in Brine	

Snails in Champagne Sauce	17.0-19.0
Chili con Carne	
Cabbage Rolls	
Vegetable Soup with Meat	
Vegetable Soup	
Vegetable Cream Soup	
Tomatoe Soup	
Beans in Tomato Sauce	15.0
Tripe in Tomato Sauce	12.0-19.0
Rice with Beef	7.0-10.0
Ravioli in Tomatoe Sauce	10.0-15.0
Spaghetti in Tomato Sauce	6.0-10.0
Lentils with Bacon	
Oxtail Soup	

Temperature references, lethal rates or kinetic factor (z-values) are established and herein used as constants corresponding to your target microorganisms.
These are further used to calculate your process as a combination of time and temperature resulting to the acceptable lethality values as listed in the table.

Temperature Data Acquisition needs to be performed during the cook-chill or pasteurization process and in a predetermined sampling interval.
These captured temperatures against time data are then used to calculate the P_u/P_o-values/ C_o-values using the formula as follows:

$$PV = \int 10^{\left(\frac{T-Tref}{z}\right)} dt$$

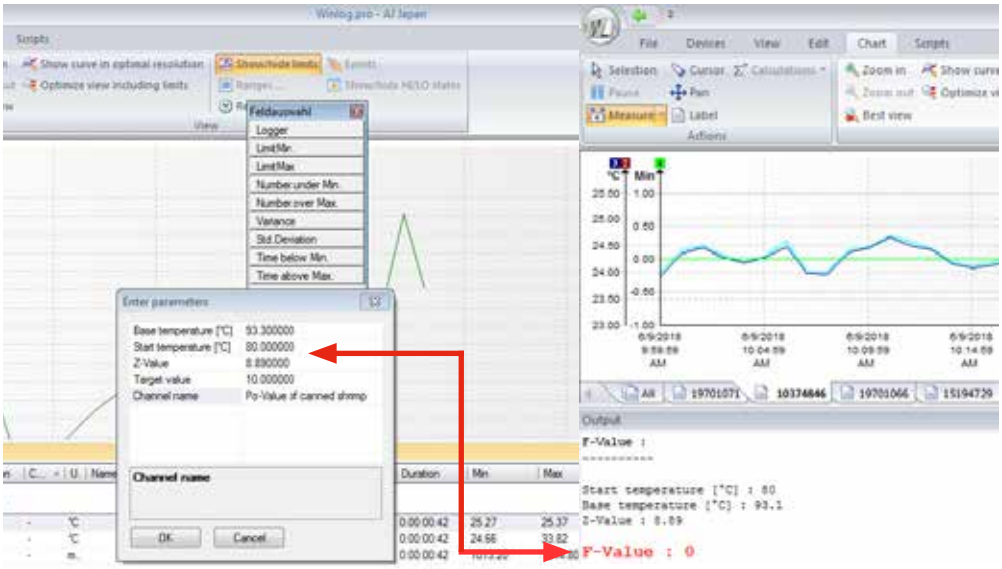
Solution:
Ebro EBI 12 , Ebro EBI 11 and the Winlog.Pro Evaluation Software

Ebro offers a complete validation package for this processing method and allows the Food Quality Management and Control Team the fast and reliable implementation of the Process Adequacy Determination procedures.

With the EBI 12's wide measuring range, it can remain in the food container for continuous measurements – from the cooking machinery to the blast freezers or chiller units.

With the EBI 12's state-of-the-art and robust engineering design, plus the accuracy from the PT1000 sensor elements that will not drift through extreme changes in temperatures, you can be assured of maintained accuracy in measurements throughout the entire duration of your cook-chill process.

The **Winlog.Pro Sofware** further reinforces your Process Adequacy measurements with the automatic P_o/P_u-value and F_o-value calculations with a few clicks as shown below:



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