Methods of Determining Heat Resistance of Bacteria & Cold Point

Subject: Fish Canning Technology
Date of Lecture: 18.05.2020

By
Dr. Abhishek Thakur
(Assistant Professor)
College of Fisheries, Kishanganj
BASU, Patna

Methods of Determining Heat Resistance of Bacteria

- Data on heat resistance of bacteria are essential to determine the processing needs of foods.
- Most of the methods employed subject suspension of a known number of spores of the reference bacteria in sealed containers to a constant temperature for varying periods and determine their survival by sub-culturing.

Methods of Bigelow and Esty

- This is a "Single tube method" known number of bacteria or spores in suspension contained in oil bath maintained at a constant temperature.
- A single tube is removed at known short intervals , rapidly cooled and cultured in a suitable medium.
- The death time is taken as that lying between the last tube showing growth on sub-culture and first tube showing no growth.
- A major disadvantage is the problem of "skips" where a tube may give no growth on sub-culture although heated for a shorter time than the tubes showing growth.

Methods of Esty & Williams

- This is called the "multiple tube method" and is a modification of the single tube method.
- Instead of a single tube removed at short intervals in the single tube method, a large number of tubes, around 25-30, are removed at each of the four widely spaced intervals.
- The percentage of the tubes giving growth for each heating period is plotted on a semi-log paper. The thermal death time of the organism at the temperature employed can be obtained from the resultant straight line graph by extrapolation.
- The multiple tube method is the one which has been most frequently used in process determinations.

Methods of Esty & Williams

- A number of other methods are available to determine the thermal death time of bacteria or spores.
- "Bulbed capillary tube method" in which the spores suspension is sealed into a bulb blown from capillary tube and is placed at the slowest heating point in a can of food.
- Actual time of exposure of the bulb to the processing temperature is compounded taking into consideration the come-up and cooling times.

Determination of Thermal Process

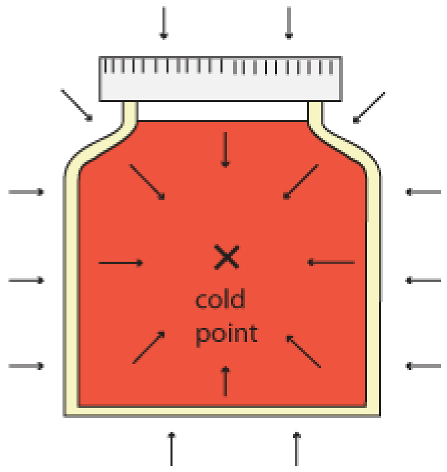
- All points inside a can do not get heated at the same rate at any given time. The point of greatest temperature lag, that is the slowest heating point in the container, is called the 'cold point'.
- Commercial sterility should ensure the process evaluation carried out based on the temperature attained by this point & integrating the lethal effect.
- It is assumed that if the cold point receives a heat process sufficient to attain commercial sterility, the all other points in the product in the can have received an equal or greater thermal process and are commercial sterile.

Determination of Thermal Process

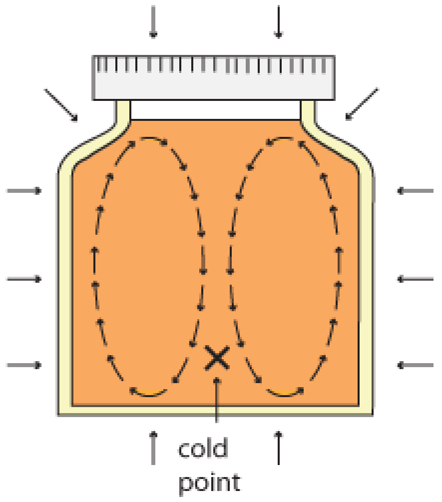
- ‘come-up-time’.
- Data on heating and cooling phase of the process are required as both these contribute to the total lethality.

Determination of Cold Point

- Products heating by conduction i.e. in solid packs, the cold point is approximately the geometric centre of the can.
- In products heating by convection the cold point is on the vertical axis near the bottom of the container.



conduction heating
(solid food in a jar)



convection heating
(liquid in a jar)

Factors Affecting Heat Penetration

- Filling
- Ingredient related factors
- Preparation related factors
- Processing related factors

Factors Affecting Heat Penetration

Filling:

- Heat penetration in can is affected by the temperature gradient between the can and the retort, the rate becoming slower as the temperature differences decreases.
- Increase in retort temp. results in more rapid heat penetration.
- Hot filled can will reach a lethal temperature more rapidly than cold filled cans.
- Cold filled can will reach a lethal temperature in about same time as a partially heated cans.
- Ratio of solid to liquid and arrangement of solid in liquid.
- Solids loosely packed in a liquid will heat more rapidly than tightly packed.
- Overfilling with solid materials will result in under processing.

Factors Affecting Heat Penetration

Ingredient related factors:

- Fatty tissues are poor conductors of heat compared to lean tissues.
- Substances that undergoes change of state during heating I'.e. sol to gel, will adversely affect the rate of heat penetration.
- Solids that absorbs water changing the solids/liquid ratio in the cans.

Factors Affecting Heat Penetration

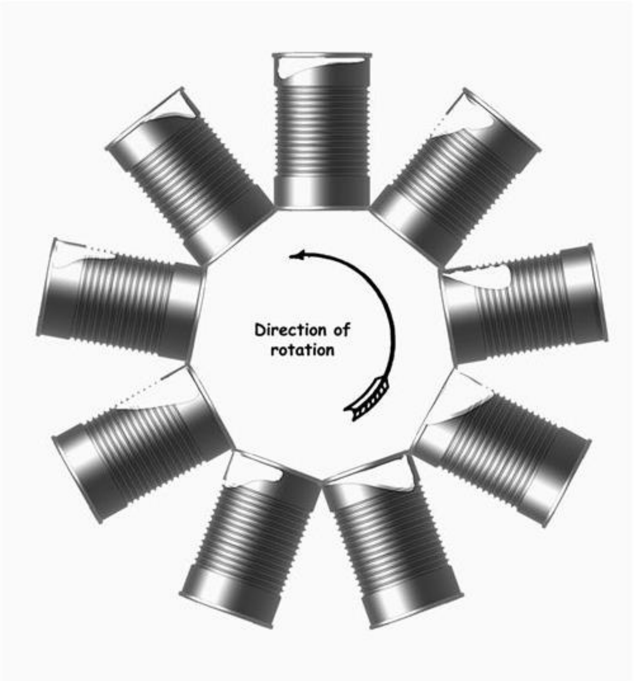
Preparation related factors:

- Use of partially thawed frozen material will cause a considerable temperature lag.
- Handling practices.

Factors Affecting Heat Penetration

Processing related factors:

- Come-up time _ 42% of the come up time should be added to the process time at the retort temperature.
- Agitation of the can during heating significantly increases the rate of heat penetration in liquid packs. It helps to transfer the heated portion of the contents to the cooler regions of the can.
- A very efficient method of increasing the rate of heat penetration is end over end agitation.
- Shape and size of the containers.
- Ratio of the surface area of the container to its volume.
- Smaller can heat more rapidly because of the large surface area in relation to the volume of the cans.


Direction of rotation

Thank You