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Thermal Death Kinetics

Practical 17 - Biological teaching-data practical

Aim

To calculate D and z values from supplied thermal-inactivation data.

Principle

Under a log-linear model, D is the time for a one-log reduction at a specified temperature. The z value is the temperature increase associated with a tenfold decrease in D. Shoulders, tails and matrix effects can violate the model.

Materials and Requirements

- Approved nonpathogenic teaching system or supplied anonymised dataset
- Laboratory risk assessment, controls and raw-data worksheet
- Approved method or teaching-data pack and a dated record sheet

Procedure

1. Define the preparation or dataset, study question and method version. Record identities, units and the criteria to be used before examining the outcome.
2. Use supplied nonpathogenic teaching data with actual temperature histories and recovery-method details.
3. Plot log10 survivors against time separately at each temperature and assess the supported linear intervals.
4. Estimate D from the negative reciprocal slope, reporting limits for counts below detection.
5. Plot log10 D against temperature to estimate z and discuss whether the model is appropriate.
6. Retain the original observations and calculations. State deviations, missing information and the limits of the conclusion; do not replace measured values with expected results.

Observations and Record

Enter actual measurements or the supplied teaching data. Record the method, material identity, conditions and units.

Preparation / control	Condition / method	Raw observation	Calculated / interpreted result
Negative / vehicle control	Specify	Record	Evaluate
Positive / reference control	Specify	Record	Evaluate
Test replicates	Specify	Record	Calculate

Calculations

- D = -1 / slope of log10 survivors versus time
- z = -1 / slope of log10 D versus temperature

Worked Example

Illustrative survivors fall from 10^6 to 10^3 in 6 min: D = 2 min. If D falls from 2.0 to 0.20 min across a 10-degree-C increase, z = 10 degrees C.

These are teaching data, not a sterilisation-process specification.

Result and Interpretation

- State organism/model, matrix, temperature and fit assumptions for each estimate.
- Report biological and technical replication separately and explain control performance.

Precautions

- Use only the approved biological system, containment and decontamination procedure.
- A teaching dataset does not authorise live animal, human-tissue or unknown-organism work.
- Keep original images and observations; avoid selecting only favourable fields or bands.

Viva Questions and Answers

Is D independent of temperature?

No; it is defined at a stated temperature and condition.

What does z express?

Temperature sensitivity of the D value.

Can a tail be ignored?

Model departures must be assessed and reported.

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