



# Quantitative Microbiological Risk Assessment (QMRA) of fresh poultry spoilage

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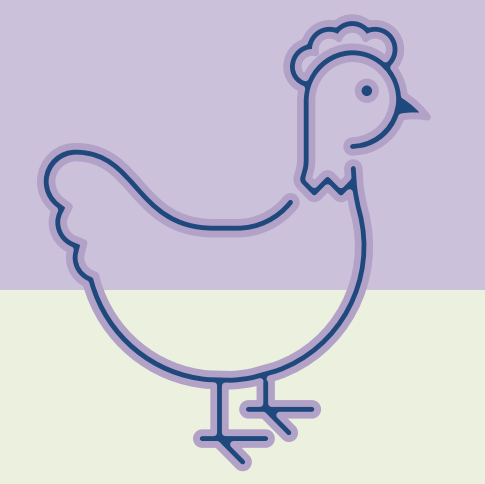


## 1 Introduction

Over the last decade, food spoilage has become a major issue with approximately **1.3 billion tons of food per year** lost or wasted globally due to **spoilage**. Specifically, **fresh poultry** are classified as **highly perishable** food products and are usually degraded within one week of slaughter, even when stored at sufficient refrigeration conditions (Tsaloumi et al, 2022). During aerobic storage, the **predominant** microorganisms are yeasts and bacteria of the genus *Pseudomonas* spp., which have been associated by many researchers with the **spoilage** of fresh poultry (Hinton et al, 2002).

## 2 Objectives

- To **develop** a probabilistic **QMRA** model for fresh poultry spoilage.
- To describe quantitatively the **heterogeneity** on the **perception** of spoilage among consumers.
- To efficiently support the FBOs in selecting an effective expiration date and assess quantitatively mitigation strategies for **controlling** the **risk** of **spoilage** and extend the shelf life of fresh poultry products.



## 3 Materials & Methods

- Data on **initial pseudomonads concentration** were collected and **kinetic parameters** were estimated (Baranyi & Roberts, 1994) for fresh chicken **breast fillets** obtained from a **Greek poultry industry** during storage at various temperatures (0, 5, 10, 15, 20, 25, 30, 35°C)
- A square root model was developed for the **effect of temperature** on the **maximum specific growth rate** of *Pseudomonas* spp. on chicken breast (Ratkowsky et al., 1982).
- Data on **retail temperature conditions** from a previous study were used (Kakagianni & Koutsoumanis, 2019).
- After **continuous distribution fittings** for initial load and retail temperature, **Pert distributions** were used to describe the data (@Risk 7.6).
- After **simultaneous microbiological and consumer sensory analysis**, a “spoilage-response” relationship was developed with a **beta-poisson model** to describe the probability that a consumer **rejects** the food at the time of package opening as a **function of pseudomonads level in the food** at that time.
- The risk of **spoilage** was **estimated** using the developed model and **scenario analysis** with Monte Carlo simulation technique.

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 Tsaloumi, S., Aspidou, Z., Spyrelli, E., Nychas, G. J. E., & Koutsoumanis, K. (2022). Development and validation of a mathematical model for pseudomonads growth as a basis for predicting spoilage of fresh poultry breast and thigh fillets. *Poultry Science*, 101985.

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## 4 Results & Discussion

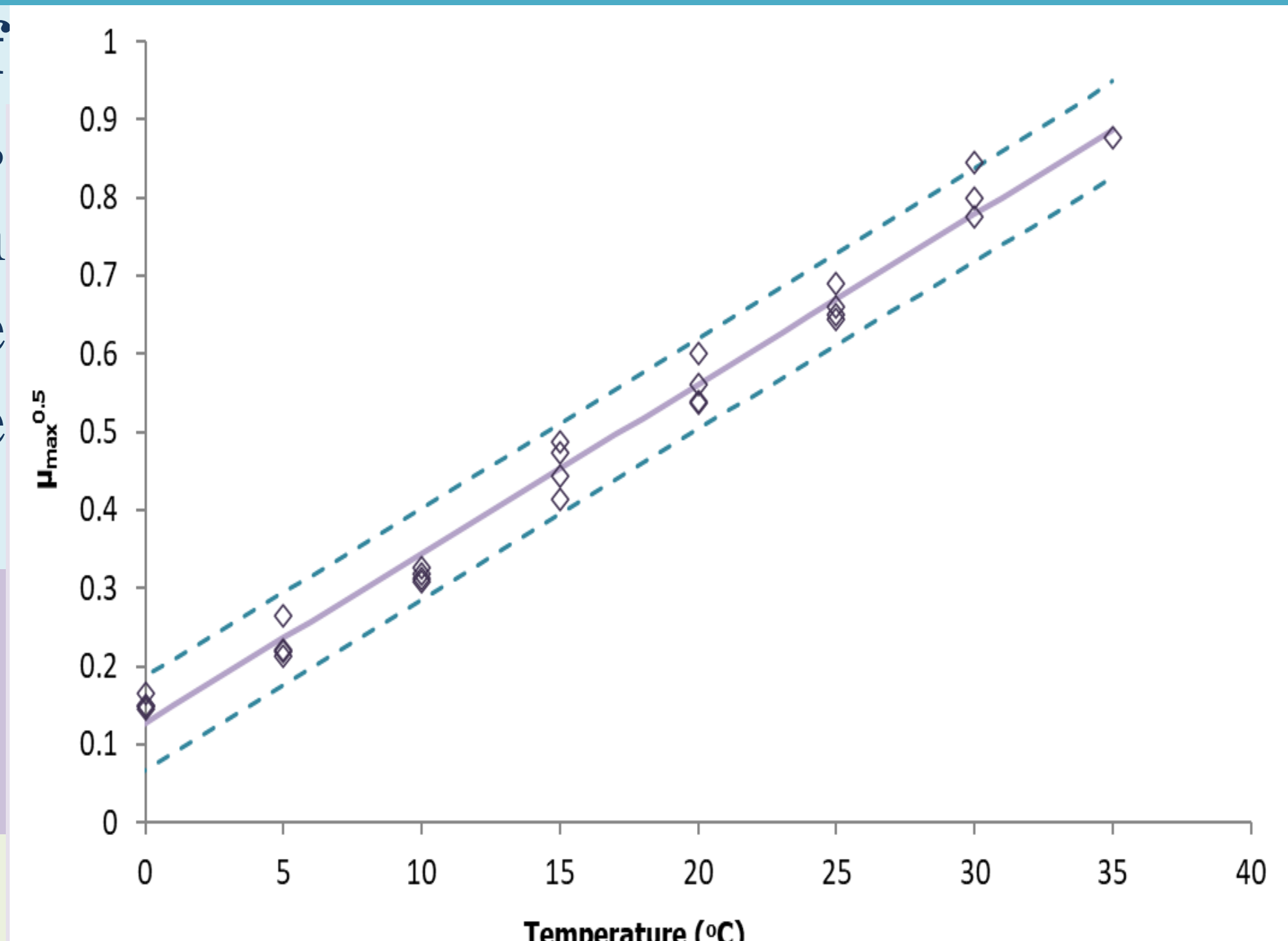


Figure 1. Square root model for the effect of temperature on the maximum specific growth rate of *Pseudomonas* spp. on chicken breast

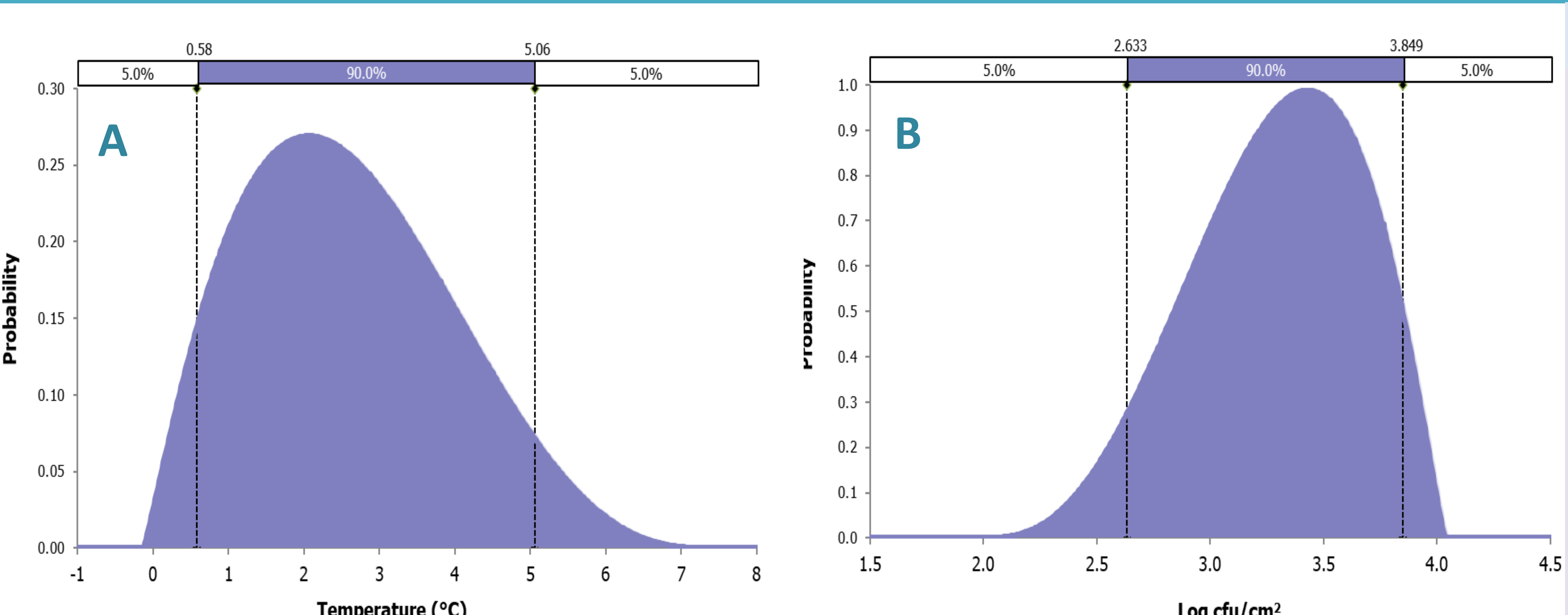


Figure 2. Pert distribution of (A) retail temperature [Pert (2.48, -0.12, 7.43)] and (B) initial population [Pert (3.33, 2.00, 4.00)]

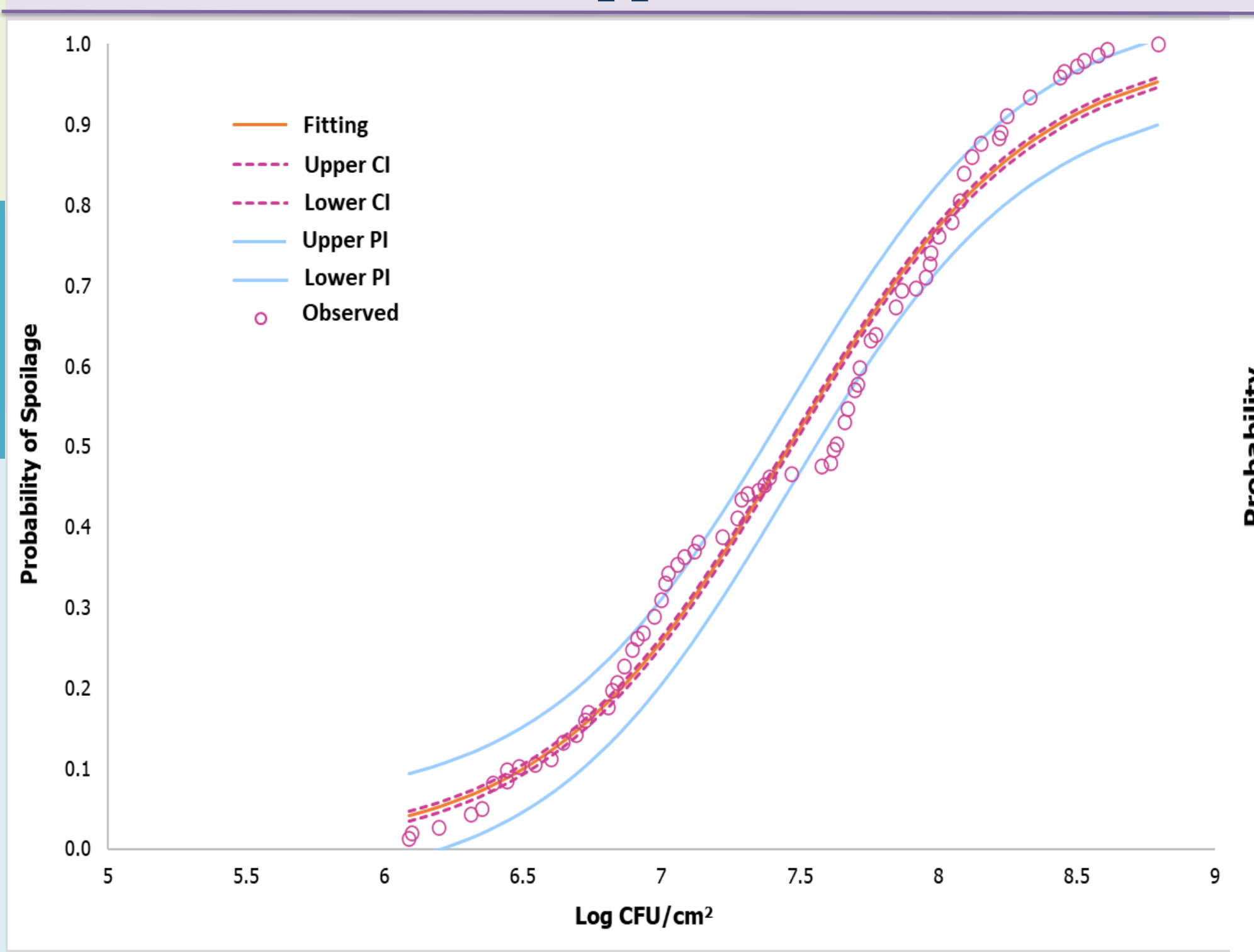


Figure 3. “Spoilage-response” relationship

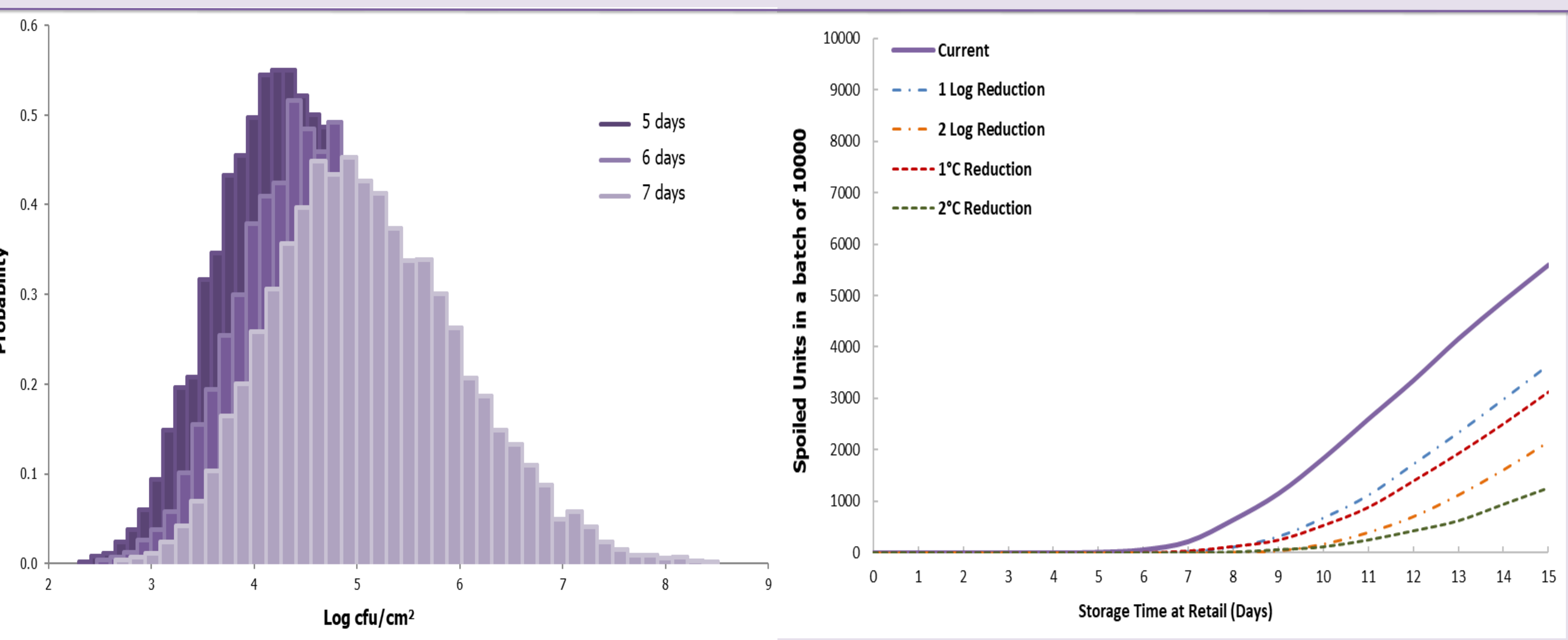


Figure 4. Pseudomonads population level after 5, 6 & 7 days of storage at retail

Figure 5. Spoiled units during retail storage after reducing initial contamination and temperature

## 5 Conclusions

- Spoilage perception** varies among consumers; No organoleptic rejection at pseudomonads concentration < **6.08 log cfu/cm<sup>2</sup>**. For **higher concentration**, a **beta-poisson** model can describe the “spoilage-response” relationship.
- For a batch of **10000 units**, the QMRA model estimated **10, 60 and 219** spoiled units after 5, 6 and 7 days of storage at retail. A **1 log reduction** of **initial microbial load** or **1°C retail storage temperature reduction** can lead to about **90% reduction of the spoiled units**.
- Spoilage QMRA model** supports managers **decision** to choose an **effective expiration date**, reducing food waste.