

Modeling Microbial Growth in Fresh Asparagus Packed in Modified Atmosphere Packaging and Vacuum Skin Packaging Microwaveable Trays


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Introduction

- Unlike other products such as frozen and canned food, the freshness is the key quality of fresh-cut products that are processed by using no thermal treatment

- food borne diseases caused by microbial growth are a critical concern in fresh-cut and ready-to-eat products

- It has been reported that only 1 log reduction in microbial number is achieved by washing with water
- Washing fresh produce with water mixed with a disinfectant such as chlorine can help to reduce the microbial load further 1-2 log reduction
- For effective commercial application, it is important to study the shelf life of the product packed in MAP and VSP containers
- The Modified Gompertz model has been widely used to model the kinetics of various microorganisms in food material

Objective

The objective of this study was to estimate the parameters of the Gompertz's model and provide confidence and prediction interval for the microbial growth in asparagus packed in MAP and VSP and stored at 4°C.

Methodology

Processing

Multivac T-200 machine

4ºC, 80% RH Storage

MAP

VSP

Microbial Growth

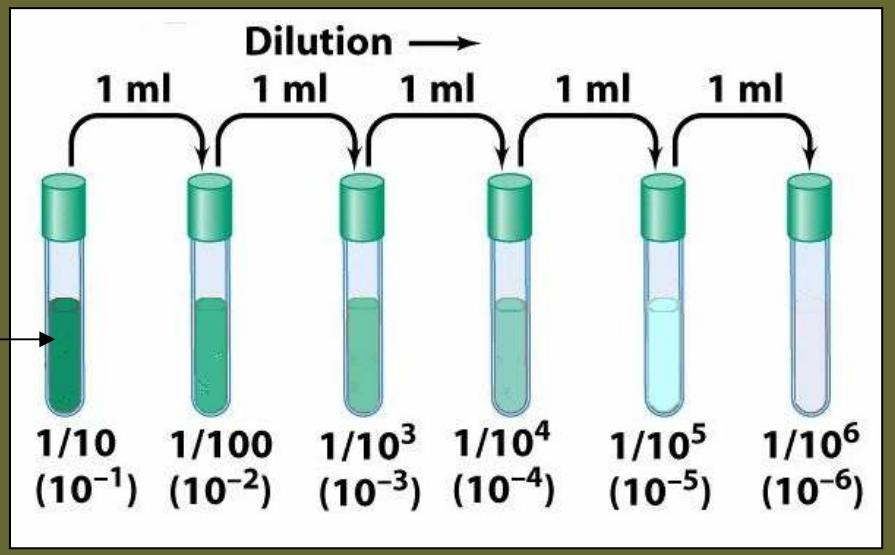
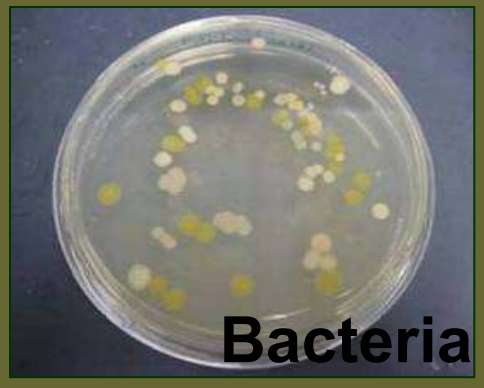
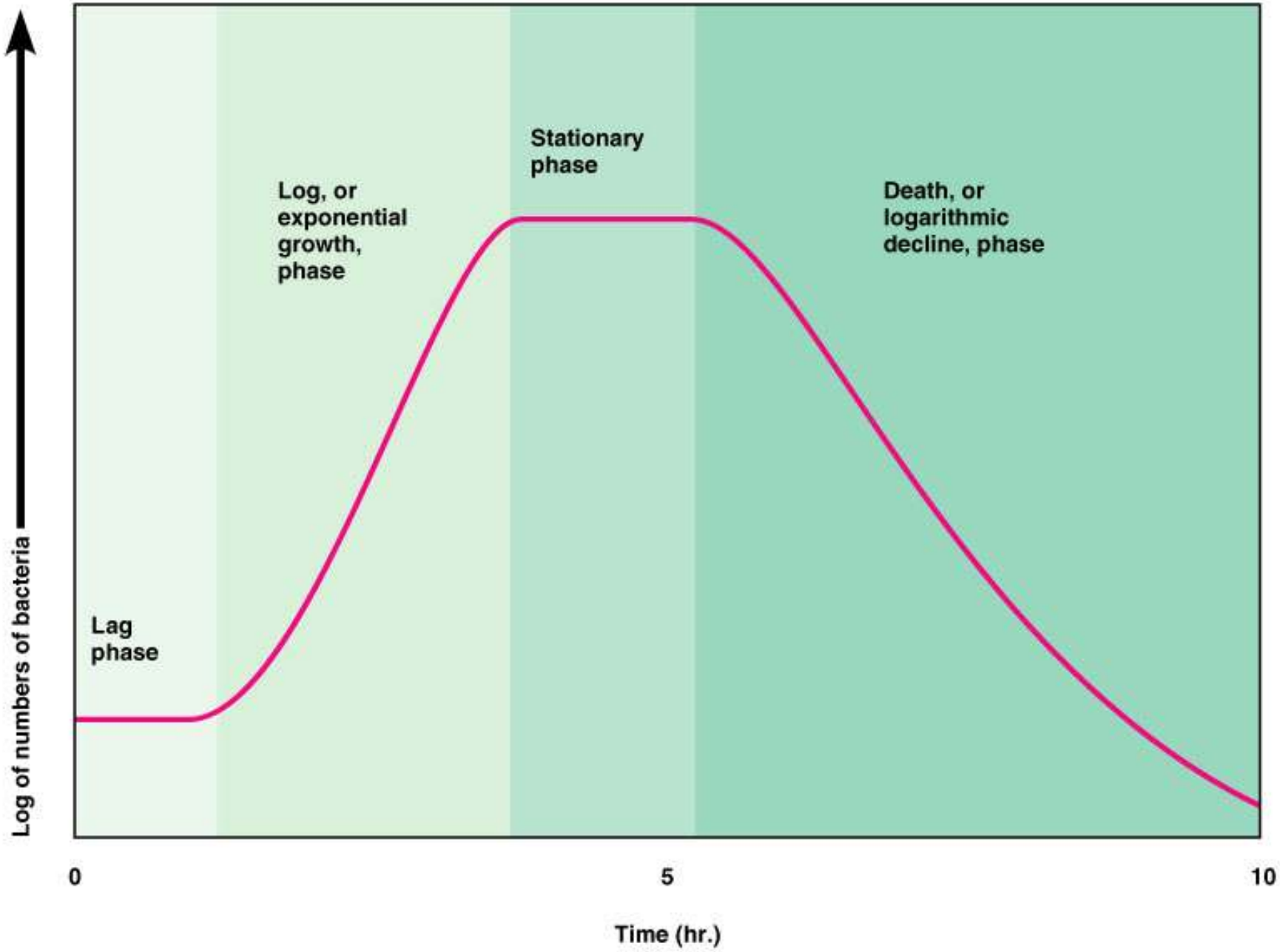


Plate 100µl of sample on Trypticase Soy Agar



$$y = \log N(t) = k + Ae^{-e\left(\frac{\mu_{\max} e}{A}(\lambda - t)+1\right)}$$

$N(t)$	CFU/g is the number of cells at time *t*
k	(log(CFU/g)) is the asymptotic count as t tends to zero
$\mu_{\max}$	(log(CFU) $g^{-1}day^{-1}$) is the maximal growth rate,
λ	lag time in days, and *t* is the time in days, and e = 2.7183
A	(log(CFU/g)) is the maximum bacterial growth at the stationary phase

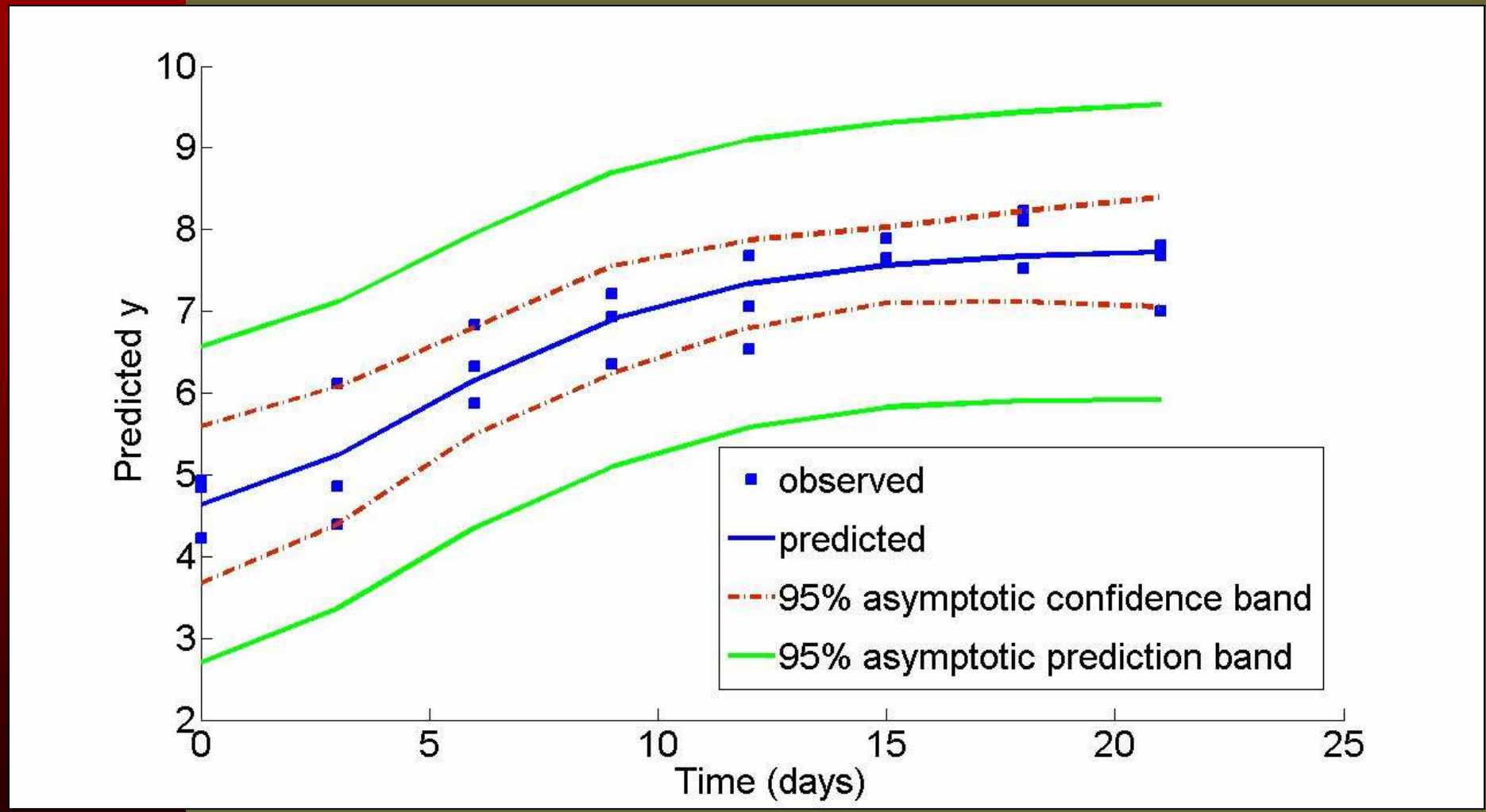


- Nonlinear regression in Matlab® was used to estimate parameters of the modified Gompertz function

[beta,r,J] = nlinfit(t,y,fun,beta0)

$$SSQ = \sum_{i=1}^{n} \left[(y)_{obs,\,i} - (y)_{pred,\,i} \right]^2$$

Result


Predicted y
Time (days)
observed
predicted
95% asymptotic confidence band
95% asymptotic prediction band
10
9
8
7
6
5
4
3
2
0
5
10
15
20
25

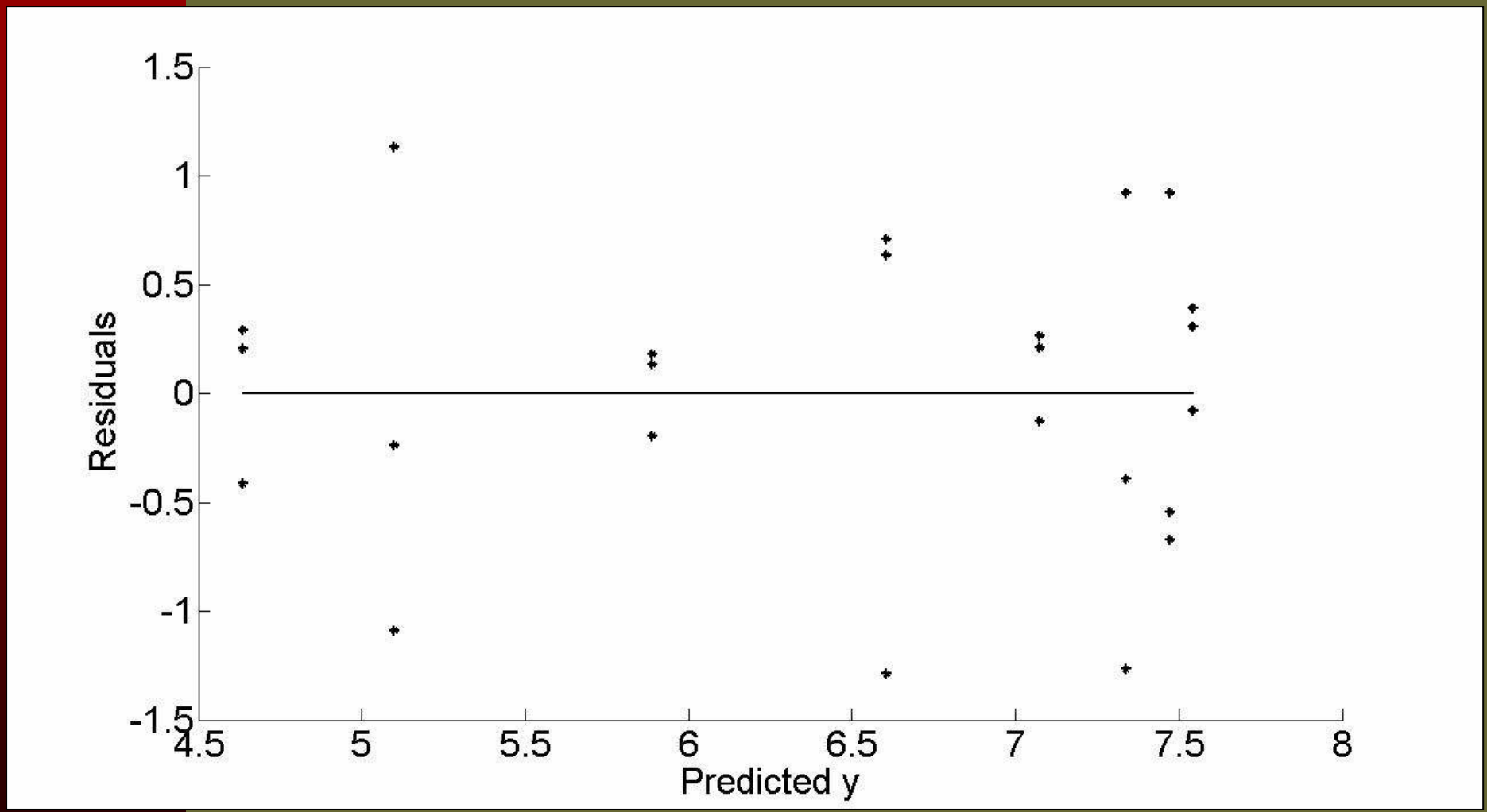
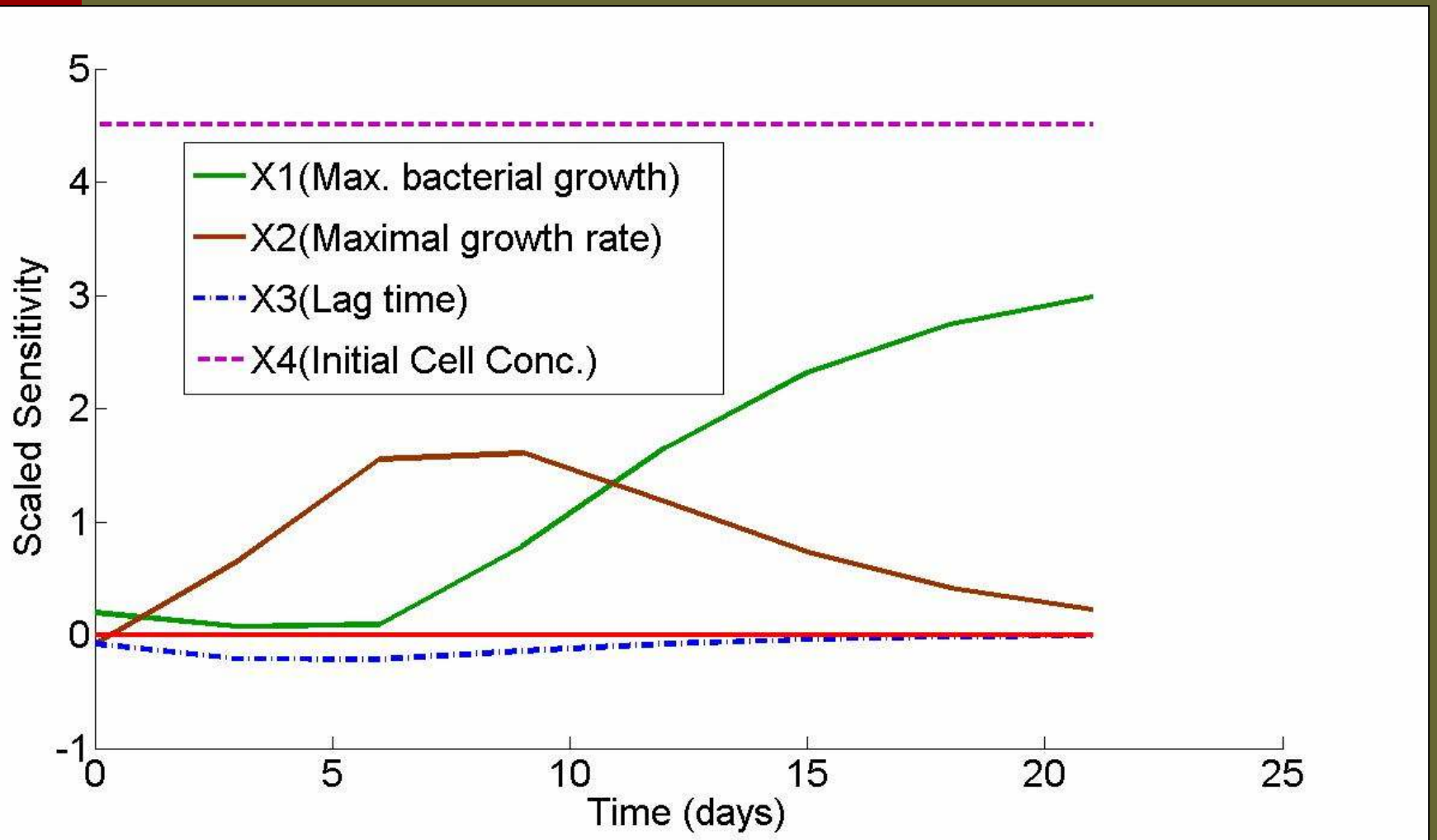

1.5
1
0.5
0
-0.5
-1
-1.5
Residuals
4.5
5
5.5
6
6.5
7
7.5
8
Predicted y

Table 1. Parameter estimates and confidence interval for the modified Gompertz model

Packaging method	Parameter	Estimated parameter	Standard error	95% asymptotic confidence interval	RMSE
MAP	$k(\log \mathrm{CFU\ g^{-1}})$	4.5	0.52	3.33, 5.67	0.78
	A	3.2	0.66	1.78, 4.75	
	μ_{max} $(\Delta(\log \mathrm{CFU\ g^{-1}\ day^{-1}}))$	0.3	0.07	0.14, 0.49	
	$\lambda(\mathrm{days})$	0.6	2.62	-5.11, 6.51	
VSP	$k(\log \mathrm{CFU\ g^{-1}})$	4.5	0.68	3.13, 5.96	0.72
	A	3.0	0.93	1.12, 4.99	
	μ_{max} $(\Delta(\log \mathrm{CFU\ g^{-1}\ day^{-1}}))$	0.3	0.10	0.06, 0.49	
	$\lambda(\mathrm{days})$	1.1	3.99	-7.21, 9.43	


X1(Max. bacterial growth)
X2(Maximal growth rate)
X3(Lag time)
X4(Initial Cell Conc.)
Scaled Sensitivity
Time (days)
5
4
3
2
1
0
-1
0
5
10
15
20
25

Conclusion

- The method shown to model the microbial growth is very pertinent for the fresh cut and packed produce
- The parameters of the modified Gompertz model can be estimated using the nonlinear regression
- For this particular study, it has also been shown that lag time may not be estimated well. One solution to this problem would be to reduce the number of parameters in the model as represented by the sensitivity coefficient analysis


Thank you