# FOOD LOSS AND WASTE REDUCTION AND RECOVERY, UNIVERSITY OF MAURITIUS

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Lefapha la Disaense tša Tlhago le Temo

Make today matter

# The difference between

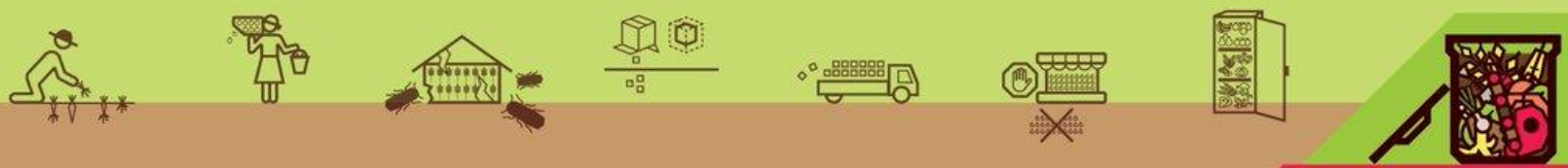
## FOOD LOSS & FOOD WASTE

takes place at

**Production**
**Postharvest**
**Processing stages**
**Distribution**

happens at

**Retail**
**Consumption**



Food and Agriculture Organization of the United Nations

#ZeroHunger

**Inconsistency** in date labeling **contributes to misunderstanding** about how dates on labels relate to **food quality or safety.**

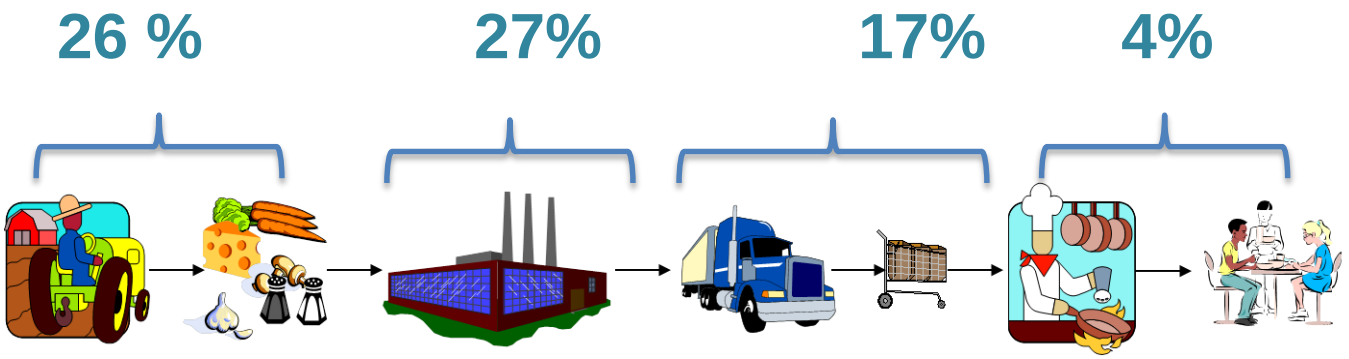

Ift.org


25%
Discarded food based on the **sell by date**.
37%
Discarded food past the **use by date.**
10%
Believe eating food past its **best by date** is a serious health risk.

lft.org

Oelofse, 2013

# SA produces an estimated **9.04-million tons** of food waste a year, creating food insecurity



# Overview

- Shelf life estimation of RTE food products
- Evaluation of:
  - Shelf life of RTE food products in South Africa
  - Food safety implications of extended shelf life of RTE food products in South Africa
- Performance evaluation of tertiary predictive models for application in shelf life estimation

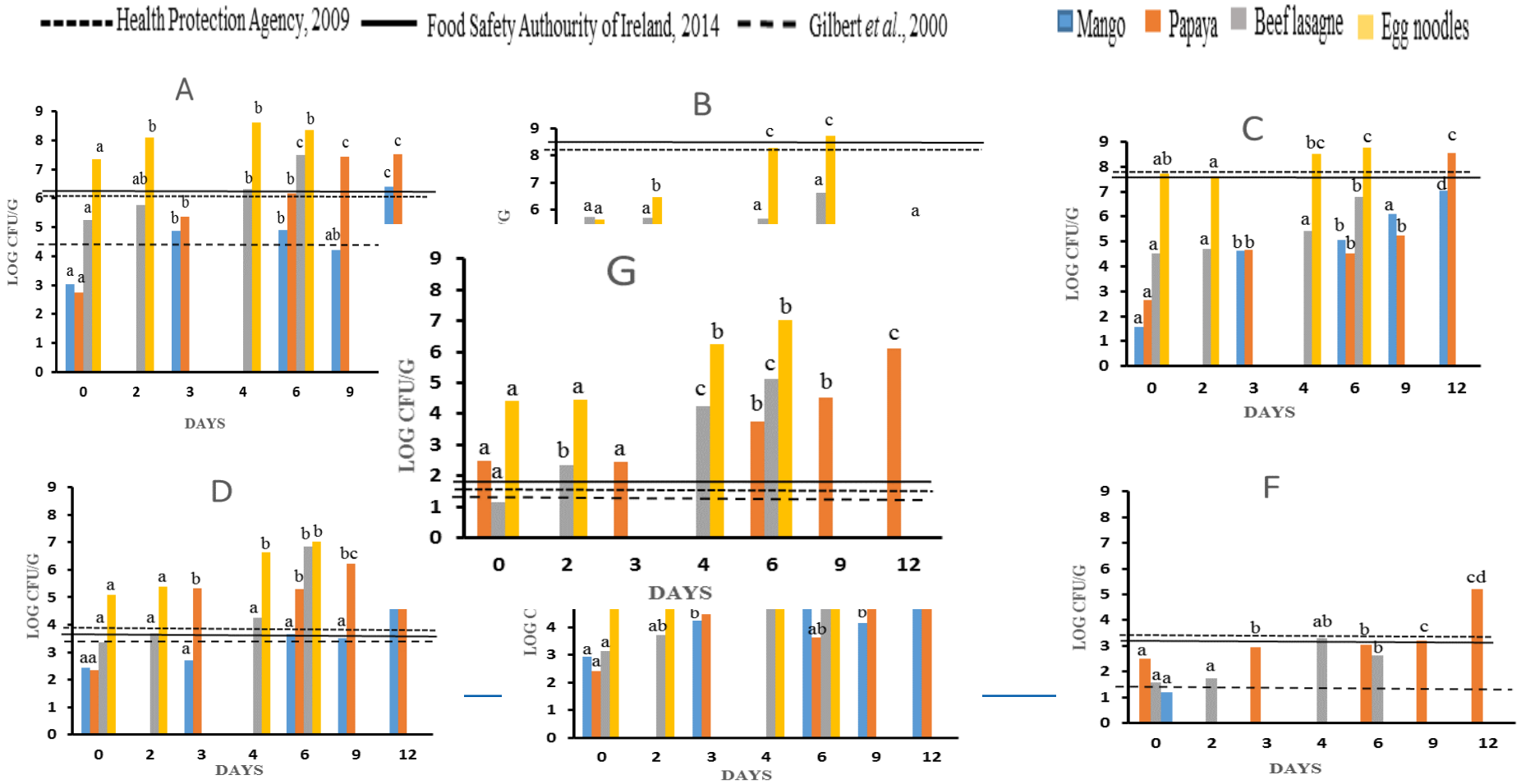
# PHASE 1

**Shelf life estimation and how growth of microorganisms impacting shelf life (using scenarios from New Zealand Guidance document, 2014) of four selected RTE products purchased at supermarkets in Hatfield, South Africa**

| RTE FOOD PRODUCTS | SET SHELF LIFE (Days)* | SHELF LIFE ATTAINED (Days)♯ | SCENARIO CATEGORYβ | SCENARIO CATEGORY ATTAINED ¥ |
|---|---|---|---|---|
| Pre-cut mango | 4 (day 3) | 12 (day 12) | 3 | 3 |
| Pre-cut papaya | 4 (day 3) | 6 (day 6) | 2 | 1 |
| Beef lasagne | 3 (day 2) | 4 (day 4) | 1 | 1 |
| Egg noodles | 3 (day 2) | - | 2 | 1 |

Shelf life set by FBO (indicates remaining shelf life after purchase), ♯ Shelf life attained during study, β Scenario category selected before microbiological study, ¥ Scenario category attained during study

**Microbial count and shelf life of pre-cut mango, pre-cut papaya, beef lasagne and egg noodles stored at 5°C for 6 and 12 days. A- TVC; B- LAB; C- *Pseudomonas* spp. ; D- *Enterobacteriaceae;* E- Yeasts and Moulds; F-*Staphylococcus aureus;* G- *E. coli***



# Phase 1 conclusions

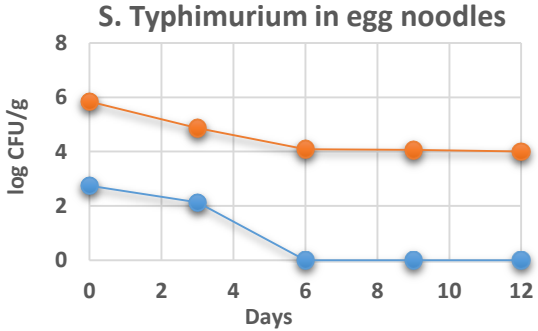
- Conservative determination of shelf life by FBO a major cause of food waste

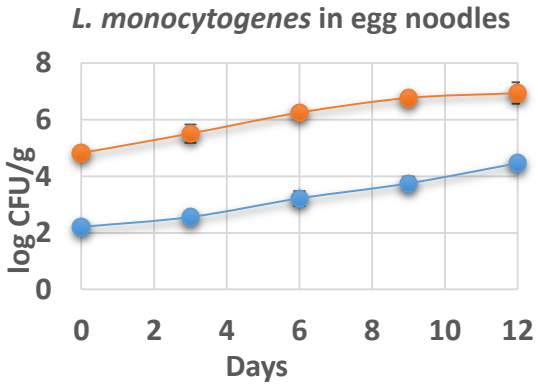
- Most RTE food products have longer shelf life compared to that estimated by the FBO
- Compromised shelf life mainly due to ***safety*** and not ***spoilage***
  - Suggesting food safety management system issues

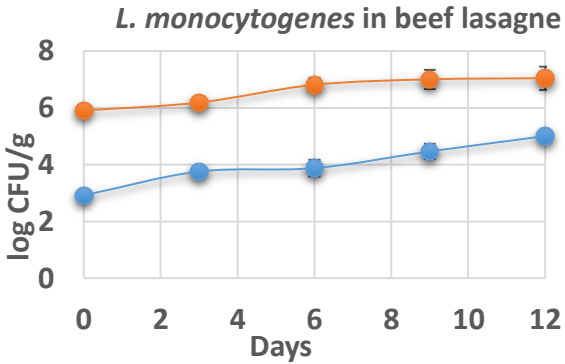
- Need for food producers to scientifically (using predictive modelling) determine shelf life of RTE food products. This will minimise risk of:
  - Unwarranted disposal of wholesome food
  - Consumers buying spoilt or unsafe food

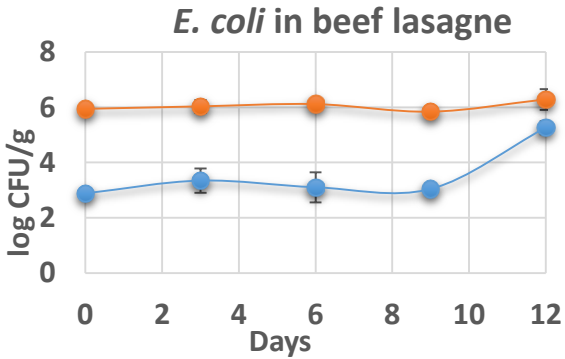
# Phase 2

**Challenge test to observe the behaviour of relevant foodborne pathogens at low inoculum level of 3 log $_{10}$ cfu/g and high inoculum level of 6 log $_{10}$ cfu/g in selected RTE food products as observed during storage for 12 days at ± 5ºC**



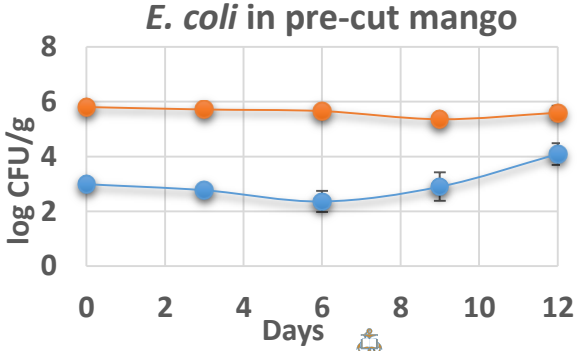







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# Growth potential (δ) result for the different relevant pathogens at low and high inoculum levels inoculated in selected RTE food products stored at ± 5ºC for 12 days

| Food Products & Pathogen | Storage period (Day) | Growth Potential (δ)* |
|---|---|---|
| S. Typhimurium - 3 $\log_{10}$ cfu/g | | |
| | Day 3 | -0.61 |
| | Day 6 | -2.74 |
| | Day 9 | -2.74 |
| 6 $\log_{10}$ cfu/g | Day 12 | -2.74 |
| | Day 3 | -0.97 |
| | Day 6 | -1.75 |
| | Day 9 | -1.78 |
| | Day 12 | -1.84 |
| *L. monocytogenes* - 3 $\log_{10}$ cfu/g | | |
| | Day 3 | 0.35 |
| | Day 6 | 1.01 |
| | Day 9 | 1.54 |
| 6 $\log_{10}$ cfu/g | Day 12 | 2.25 |
| | Day 3 | 0.69 |
| | Day 6 | 1.43 |
| | Day 9 | 1.95 |
| | Day 12 | 2.12 |

- Growth potential calculated by difference of counts between day 0 and remaining storage period (days 3 to 12);
- Day 0 represents the day of sample purchase (after pathogen inoculation); Day 3 represents the end of shelf life as indicated by FBO; Day 12 represents end of storage period in this study

## Growth potential (δ) result for the different relevant pathogens at low and high inoculum levels inoculated in selected RTE food products stored at ± 5°C for 12 days

| Food Products & Pathogen | Storage period (Day) | Growth Potential (δ)* |
|---|---|---|
| Beef lasagne | | |
| *L. monocytogenes* - 3 $\log_{10}$ cfu/g | Day 3 | 0.84 |
| | Day 6 | 0.96 |
| | Day 9 | 1.55 |
| | Day 12 | 2.09 |
| 6 $\log_{10}$ cfu/g | Day 3 | 0.28 |
| | Day 6 | 0.90 |
| | Day 9 | 1.09 |
| | Day 12 | 1.13 |
| *E. coli* - 3 $\log_{10}$ cfu/g | Day 3 | 0.46 |
| | Day 6 | 0.22 |
| | Day 9 | 0.16 |
| | Day 12 | 2.38 |
| 6 $\log_{10}$ cfu/g | Day 3 | 0.09 |
| | Day 6 | 0.17 |
| | Day 9 | -0.1 |
| | Day 12 | 0.34 |
| Pre-cut mango | | |
| *E. coli* - 3 $\log_{10}$ cfu/g | Day 3 | -0.22 |
| | Day 6 | -0.63 |
| | Day 9 | -0.09 |
| | Day 12 | 1.10 |
| 6 $\log_{10}$ cfu/g | Day 3 | -0.09 |
| | Day 6 | -0.15 |
| | Day 9 | -0.45 |
| | Day 12 | -0.21 |

- Growth potential calculated by difference of counts between day 0 and remaining storage period (days 3 to 12);
- Day 0 represents the day of sample purchase (after pathogen inoculation); Day 3 represents the end of shelf life as indicated by FBO Day 12 represents end of storage period in this study

# Phase 2 conclusions

- Shelf life of RTE food products can be extended with regards to behaviour of relevant pathogens
  - Salmonella Typhimurium: will not survive and will be inactivated in egg noodles (9 days extension)
  - *L. monocytogenes* and *E. coli* in beef lasagne (6 to 9 days extension)
  - *L. monocytogenes* in egg noodles (6 days extension)
  - *E. coli* in pre cut mangoes (9 days extension)

- Growth of pathogens, pose no food safety risk as it is slow (< 2 log increase) over shelf life extension

- Still important to highlight the risks involved in the consumption of RTE food products for consumer health, to raise consumer awareness and remind manufacturers to monitor hygiene during food production and storage

- Behaviour of pathogens generated growth data for *L. monocytogenes* and *E. coli* while non-thermal inactivation was generated for Salmonella Typhimurium.
  - Data used in comparing the predicted data generated from the next research chapter

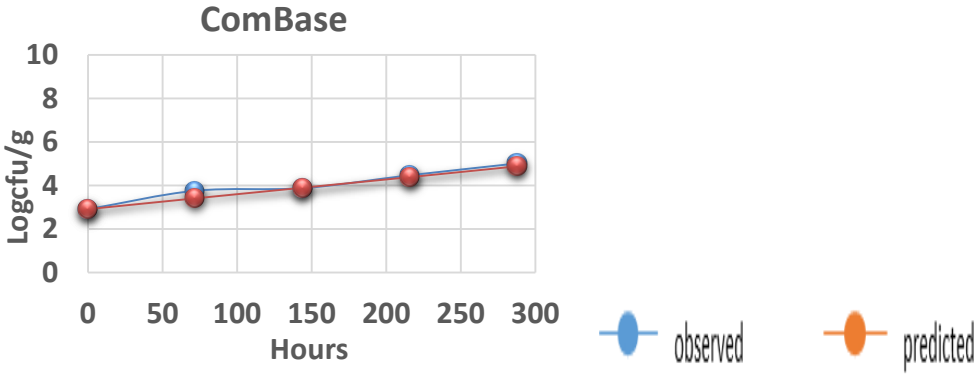
# Phase 3

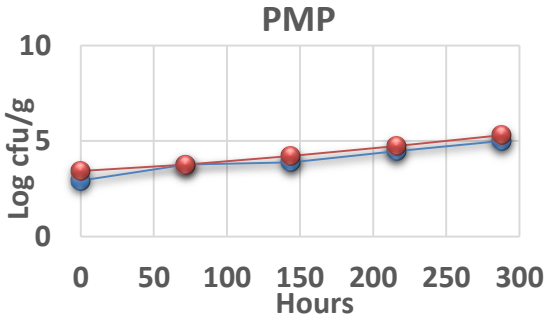
- Data generated from ***challenge test* studies** to observe the behaviour of ***L. monocytogenes*** in RTE beef lasagne and egg noodles was **compared** with the data generated from **software predictions**.

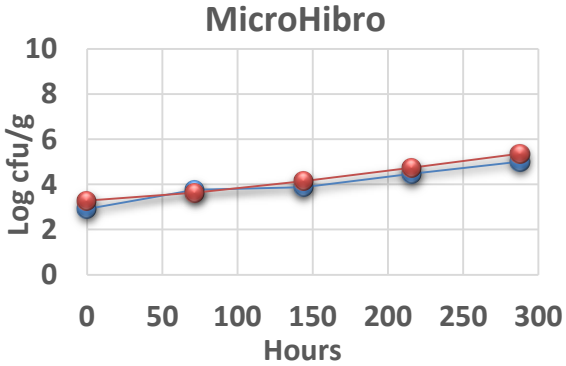
❑ **Software:**

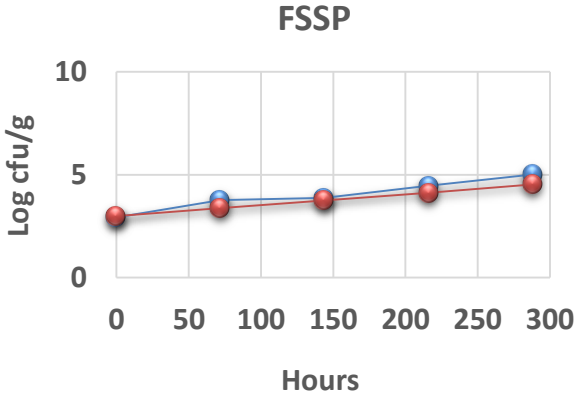
- **PMP**
- **ComBase**
- **MicroHibro**
- **FSSP**

**Growth curve of predicted versus observed data for the different types of software used for prediction of *L. monocytogenes* growth at low (3 log $_{10}$ cfu/g) inoculum level in beef lasagne**

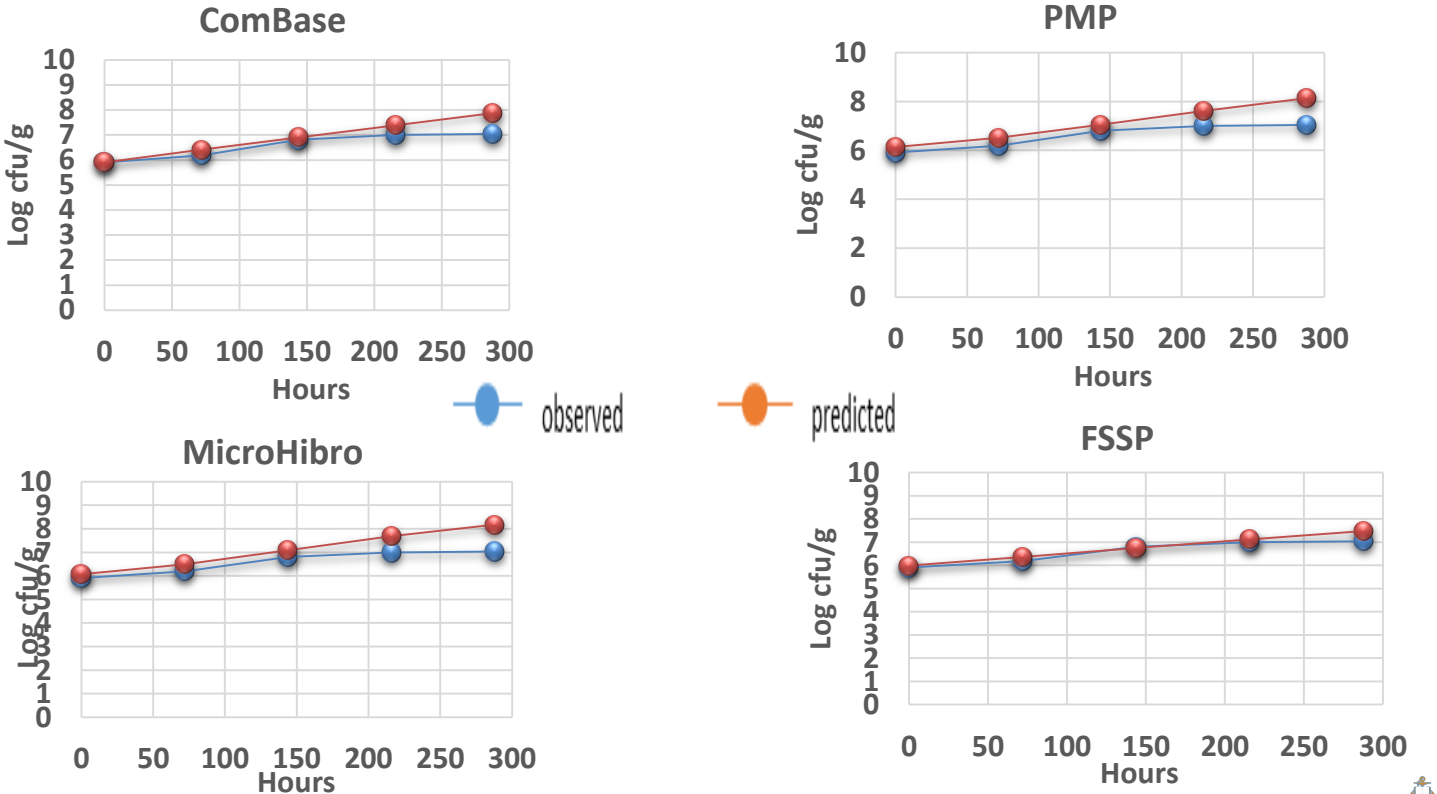


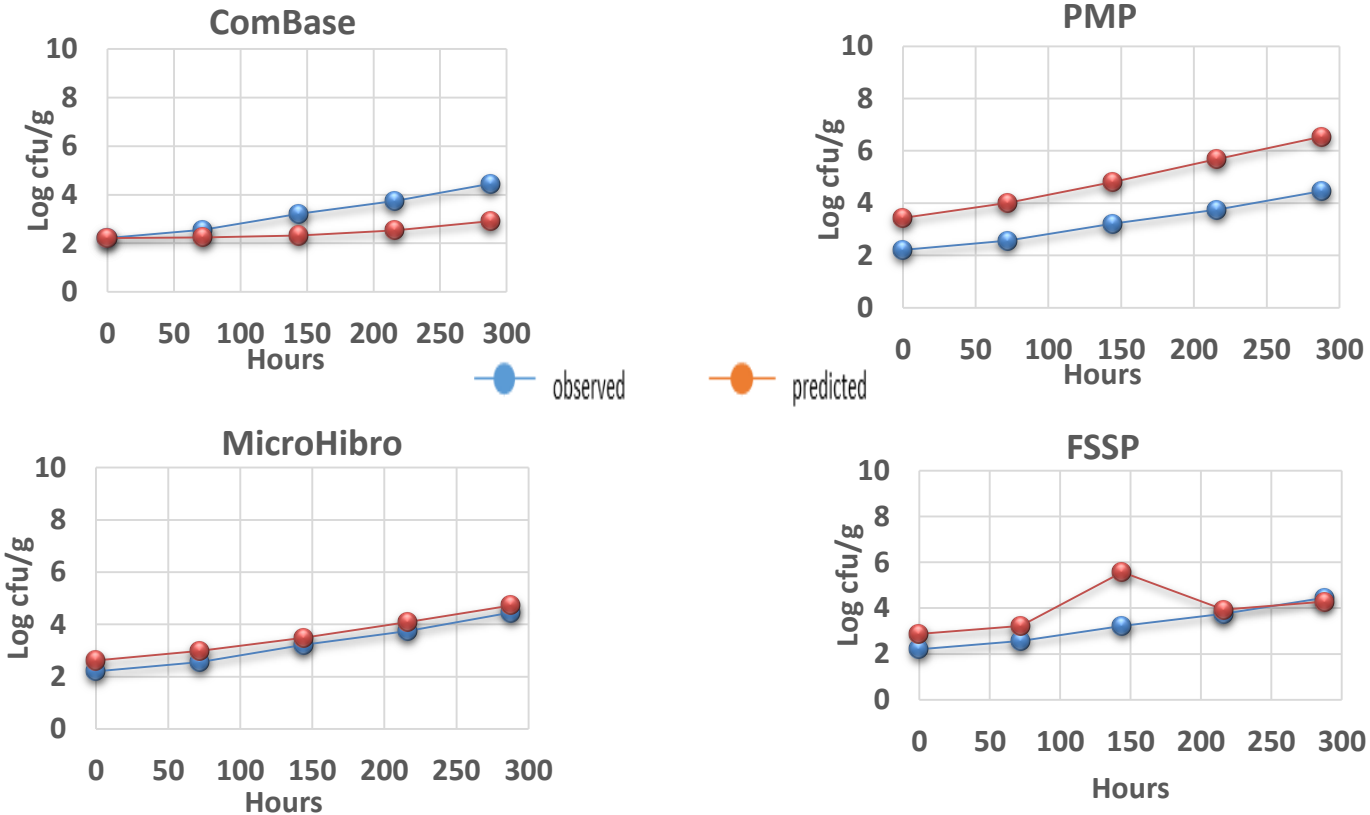



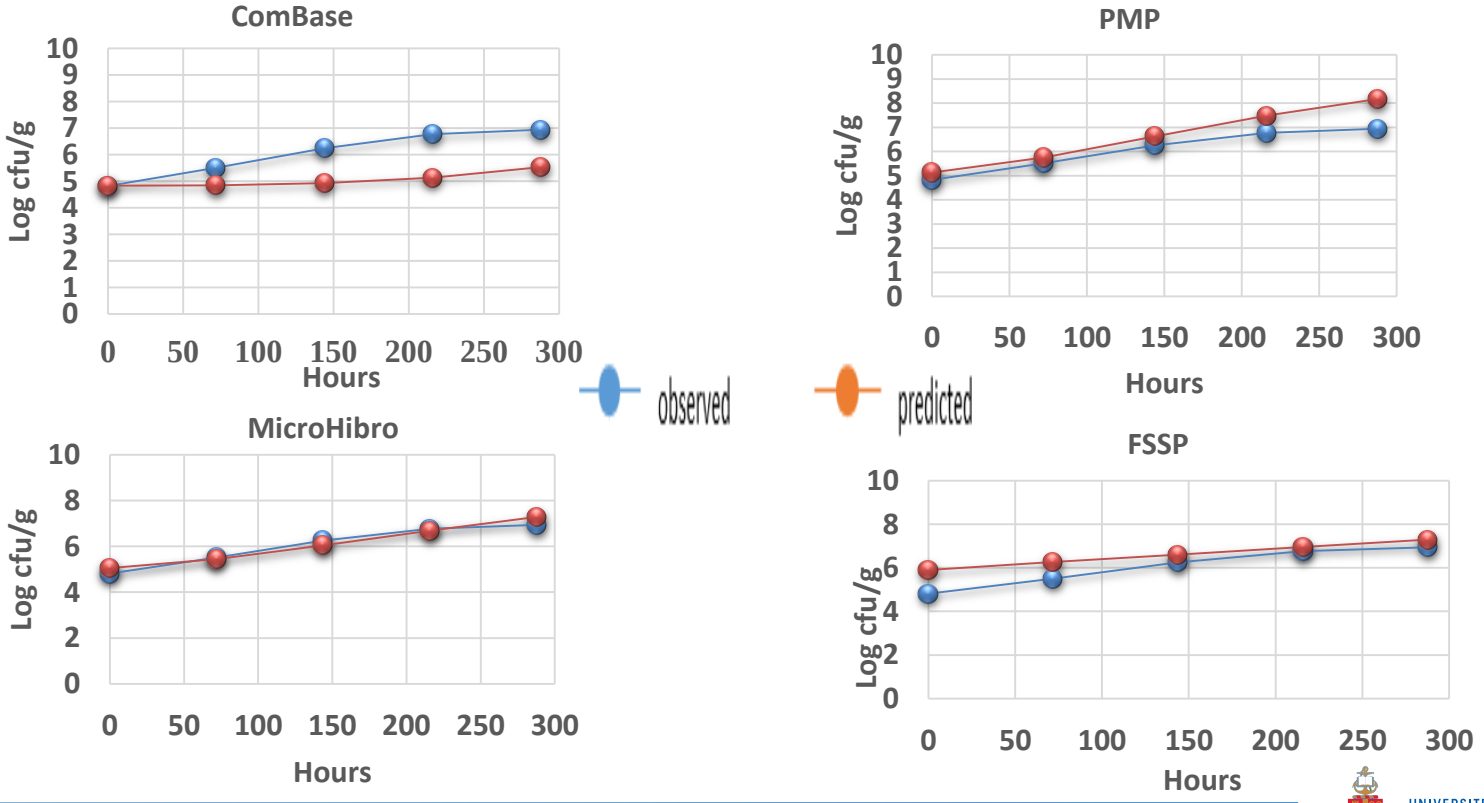
**Growth curve of predicted versus observed data for the different types of software used for prediction of *L. monocytogenes* growth at high (6 log $_{10}$ cfu/g) inoculum level in beef lasagne**



**Growth curve of predicted versus observed data for the different types of software used for prediction of *L. monocytogenes* growth at low ($3 \log_{10}$ cfu/g) inoculum level in Egg noodles**



**Growth curve of predicted versus observed data for the different types of software used for prediction of *L. monocytogenes* growth at high (6 log 10 cfu/g) inoculum level in egg noodles**



# Performance evaluation of selected software predicting the growth of *L. monocytogenes* on beef lasagne and egg noodles under the same environmental conditions

| Food product | Inoculation level | Indices of performance | Software | | | |
|---|---|---|---|---|---|---|
| | | | ComBase | PMP | MicroHibro | FSSP |
| Beef lasagne | 3 log $_{10}$ cfu/g | $y_o$ | 2.91 | 3.43 | 3.28 | 2.99 |
| | | $y_f$ | 4.89 | 5.30 | 5.37 | 4.52 |
| | | $\mu_{max}$ | 0.007 | 0.23 | 0.009 | 0.0122 |
| | 6 log $_{10}$ cfu/g | $y_o$ | 5.91 | 6.14 | 6.07 | 5.99 |
| | | $y_f$ | 7.87 | 8.14 | 8.17 | 7.48 |
| | | $\mu_{max}$ | 0.007 | 0.23 | 0.009 | 0.0122 |
| Egg noodles | 3 log $_{10}$ cfu/g | $y_o$ | 2.22 | 3.43 | 2.62 | 2.87 |
| | | $y_f$ | 4.52 | 6.55 | 4.73 | 4.28 |
| | | $\mu_{max}$ | 0.008 | 0.29 | 0.009 | 0.113 |
| | 6 log $_{10}$ cfu/g | $y_o$ | 4.83 | 5.13 | 5.05 | 5.90 |
| | | $y_f$ | 7.12 | 8.17 | 7.29 | 7.29 |
| | | $\mu_{max}$ | 0.008 | 0.29 | 0.009 | 0.113 |

$y_o$ – Initial cell count at day 0 predicted in $\log_{10}$ cfu/g; $y_f$ –Final cell count at day 12 predicted in $\log_{10}$ cfu/g

$\mu_{max}$ – Maximum growth rate predicted in $\log_{10}$ cfu/h

# Phase 3 conclusions

- All software performed well with a fail-safe prediction
  - prediction of *L. monocytogenes* growth in beef lasagne and egg noodles
- Products do not pose food safety risk
  - Growth of the pathogens predicted to be faster
- Application for shelf life prediction of RTE food products by the South African food industry

- ComBase software had the best performance (prediction of *L. monocytogenes* growth in beef lasagne and egg noodles)
  - Software prediction was close to the observed
  - Software application will alleviate of food waste problem (conservative shelf life prediction)
- SMEs can make use of predictive microbiology models (software) to reduce food waste in various food types

# Thank You

# WAY FORWARD

- There is a Difference between science of the idea and the product
- Expose students and woman entrepreneurs to the possibilities in food waste/loss/recovery
- Create network – supporting initiatives – not only one stakeholder
- Support students to translate the research into commercialisation
- Teach students how to pitch their ideas, passion
- Need for regular reports on initiatives – re-assess initiatives

# WAY FORWARD

- Infrastructure forms the basis for creativity and innovation
- Work towards Branding
- Encourage students, entrepreneurs, communities to find a partner – someone to help push the idea through
- There must be mutual and visible respect between the research community and business community in this endeavour – each has a role

# WAY FORWARD

- Be patient – success takes time.  Have a vision
- Academics do not have an entrepreneurial mind set – partners, networks
- Think differently about how to use, implement knowledge
- Take risks!

- Specific ideas:
    - One session of food waste/loss/ recovery solutions in each subject this year – students to brainstorm and present a solution
    - Final year projects to focus on this aspect for this year, must team up with community, entrepreneur
    - Develop food recovery SOP, CP – decision tree