Designing Healthy Foods:
beyond Farm to Fork

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Food Quality and Design Group

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Content

- Foods for Health
- Variation of Quality: QACCP
  - Breeding/Processing/Consumer
- Improving Quality:
  - Linking Plant and Food Science
  - Quality based Process optimisation
  - Linking Consumer and Food Science
- Future prospects
  - Linking Food Science & Nutrition:
  - Modelling human digestion/physiology vs processing
- Take home message

Plant Foods for Health

Epidemiology:

Risk Reduction: Plant Foods vs. Chronic Diseases:
Cancers, Cardio Vascular Diseases, Diabetes, etc..

What is Mechanism?
What are the Active Components?

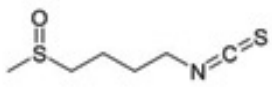
Plants contain:

- Water
- Micronutrients
- Fibre
- **& Secondary Metabolites**

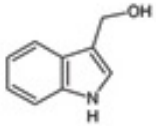
Secondary Plant Metabolites

Some examples from > 10,000 compounds:

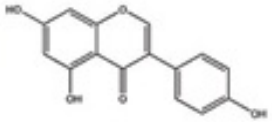
Broccoli *Sulphoraphane*



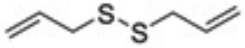
Cabbage *SIndole-3carbinol*



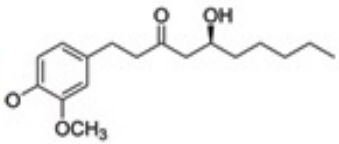
Soybeans *Genistein*



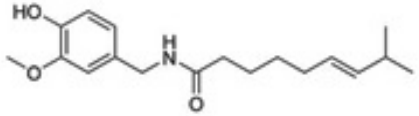
Garlic *Diallyl sulphide*



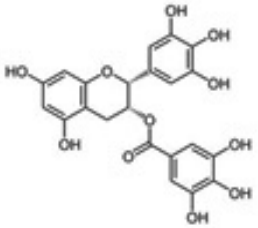
Ginger *Gingerol*



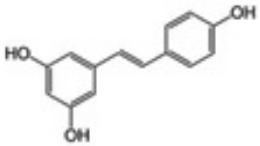
Chilli peppers *Capsaicin*



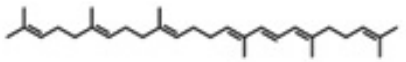
Green Tea *Epigallocatechin-3gallate*



Grapes *Resveratrol*



Tomatoes *Lycopene*



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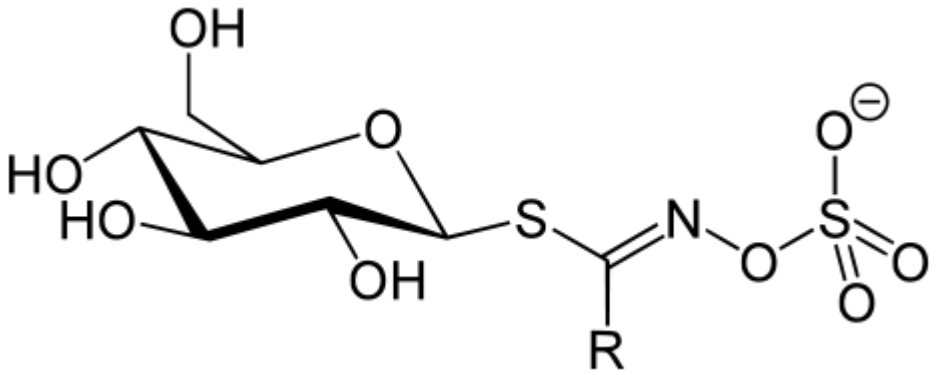
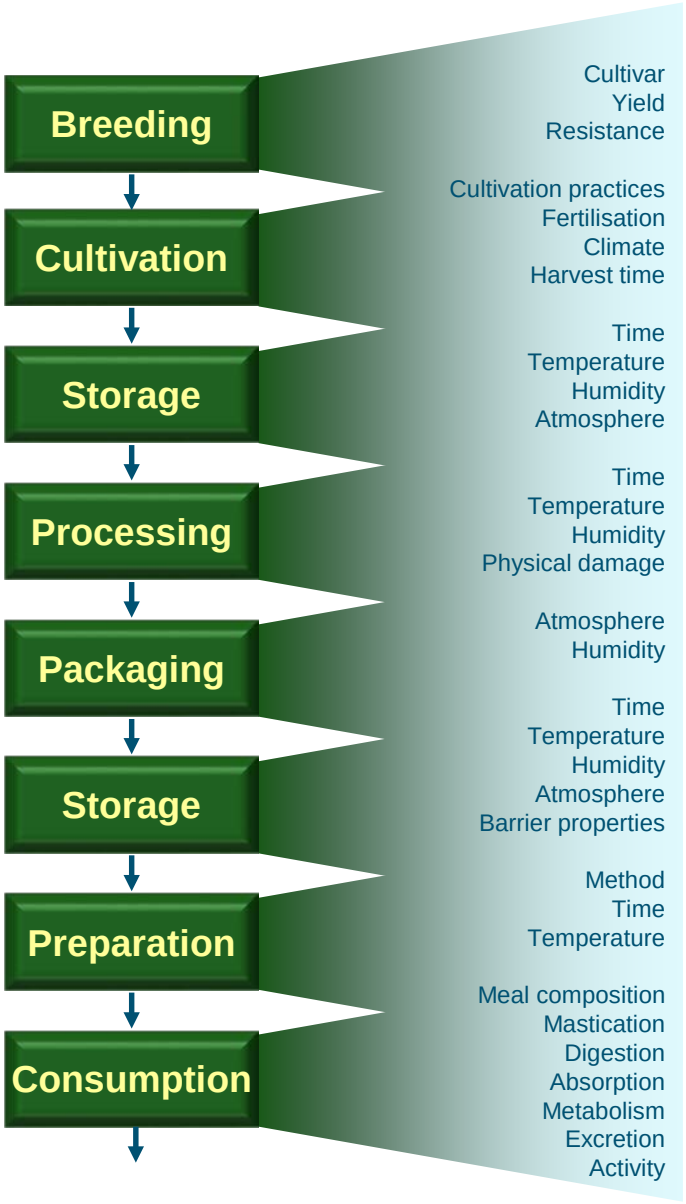
Case on Glucosinolates (*Brassicaceae*)

- Function in plant
  - Defense mechanism



- Effects for human
  - Taste/Flavour
  - Health (ITC's!)
    - Associated with reduced risk of certain cancers:
      a.o.: colon cancer
    - Induction of detoxifying enzymes (Phase II)
    - Apoptosis of tumor cells

Variability in the Production Chain



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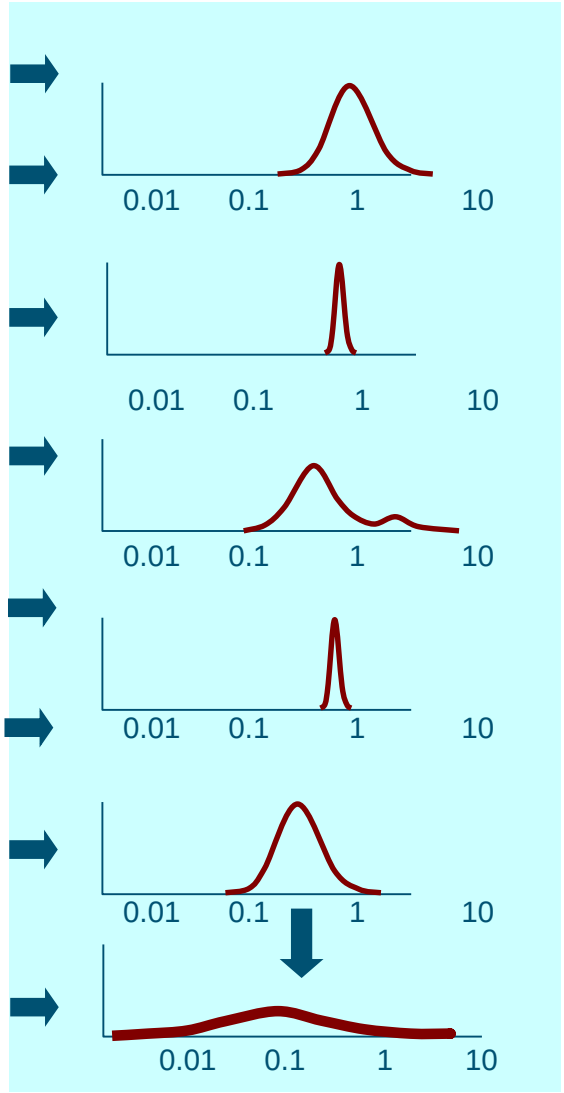
Glucosinolates from Brassica vegetables

QACCP:
Quality Analysis Critical Control Points



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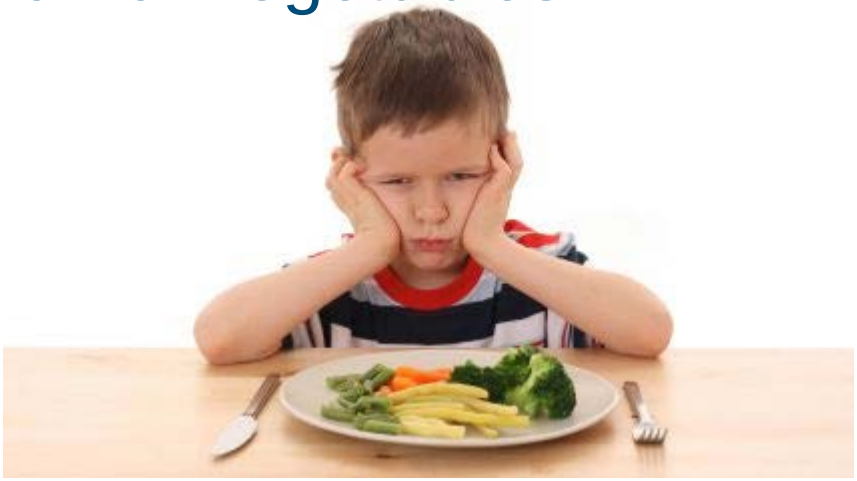
Conclusion so far...

- Enormous variation in phytochemicals in consumed products
- Product and Process Design with respect to phytochemicals has big potential for human health!!
- Supply chain approach needed

Strategies for using foods for health

- Increasing consumption of vegetables?

  Efficient?



- Improving quality?

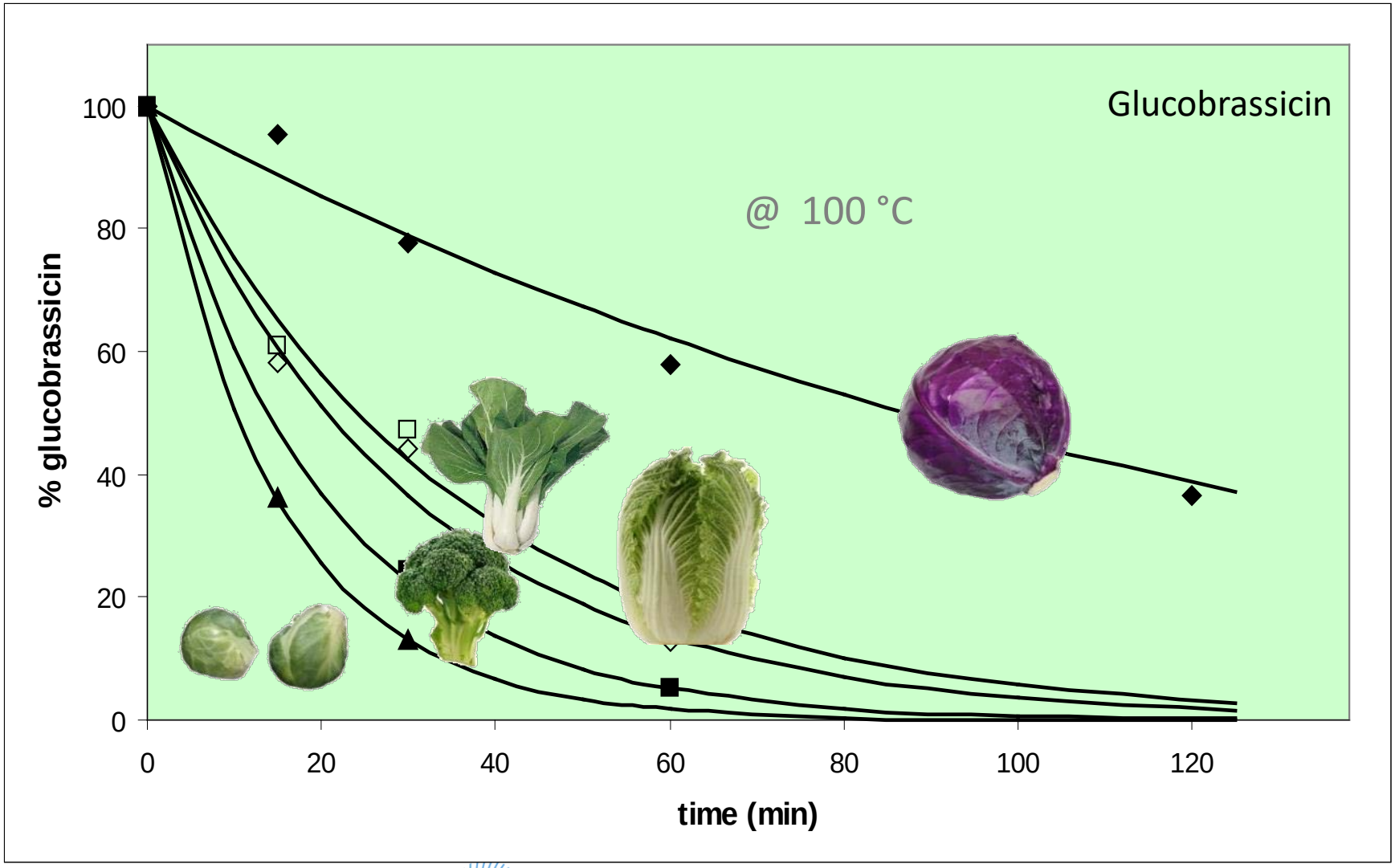
  QACCP!

  Breeding/Processing/Preparation

QACCP-1: Breeding

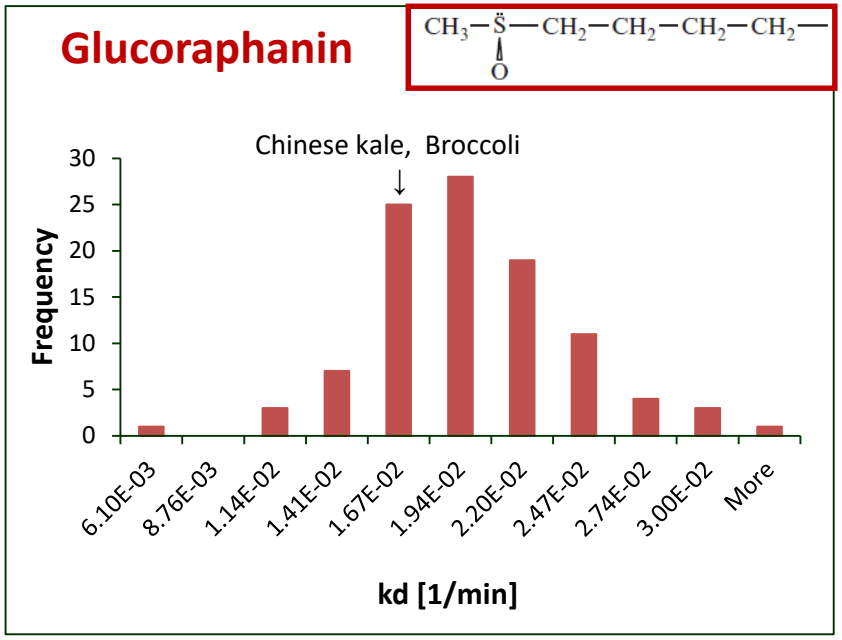
- Breeding for higher contents
- Breeding for increased stability

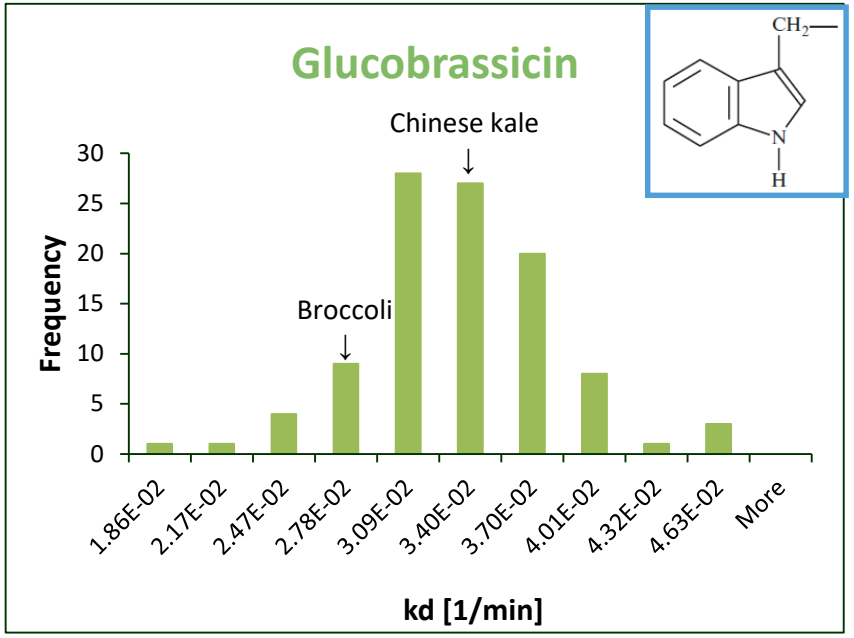
Vegetable types vs stability



Segregation of GL degradation

in ~100 lines DH population Broccoli x Chinese Kale





PhD project Kristin Hennig

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Quantitative Trait Loci identification (QTLs)

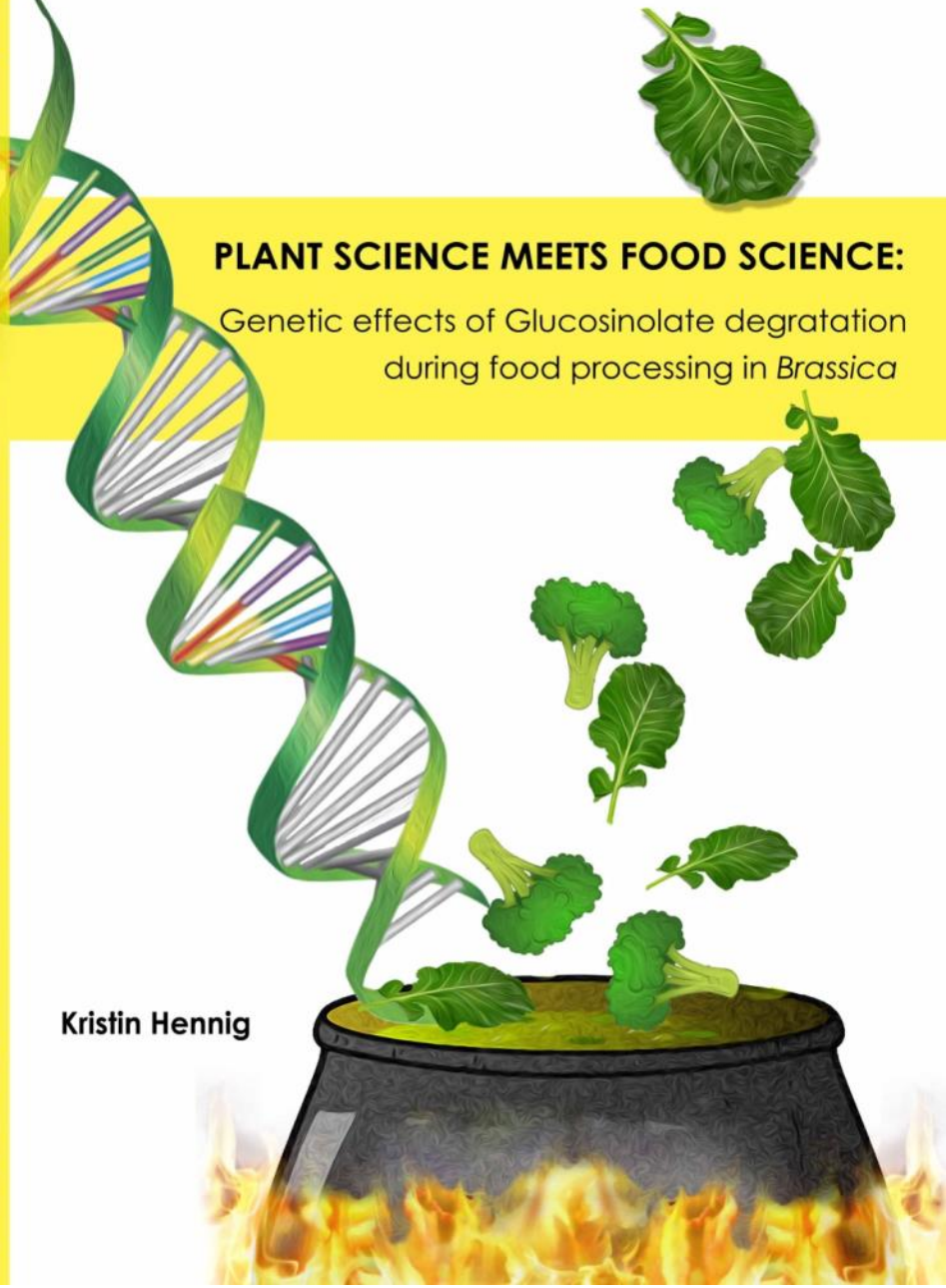
- Bio-informatics modelling tools:
  - Linking variation in process parameter values to genomic variation
  - 4 QTL on Brassica genome for degradation rate
  - Explained variation: 25-30%
  - Genetic effect
  - Environmental effect

PhD project Kristin Hennig

Plant Science meets Food Science: Genetic effects of Glucosinolate degratation during food processing in *Brassica* Kristin Hennig

PLANT SCIENCE MEETS FOOD SCIENCE:

Genetic effects of Glucosinolate degratation during food processing in *Brassica*



Kristin Hennig

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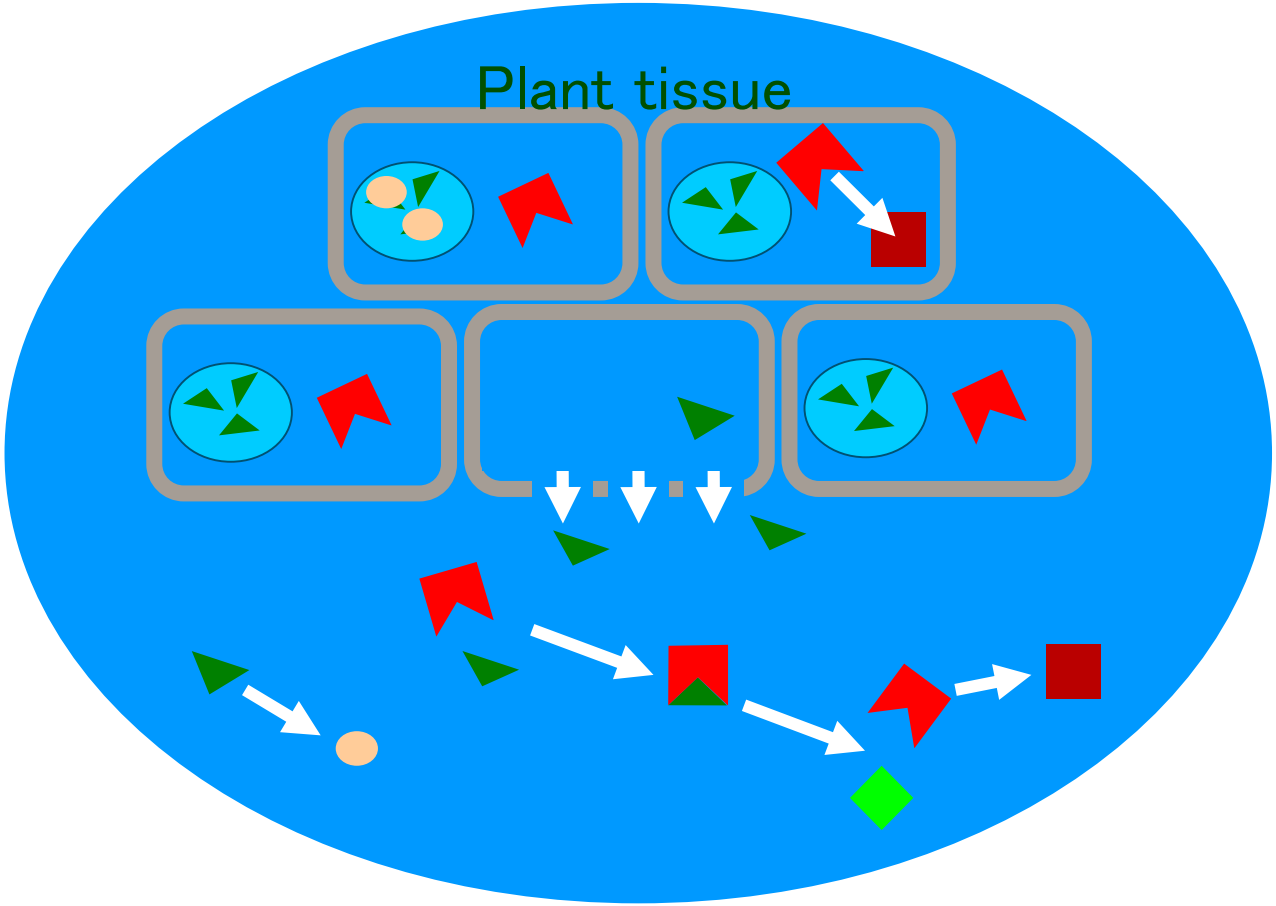
QACCP-2: Optimising processing



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DREAM

SEVENTH FRAMEWORK
PROGRAMME

Mathematical modelling

(Partial) differential equations

$$\frac{dC_i}{dt} = -k_1 \cdot C_i + k_2 \cdot C_j$$

$$\frac{dC_i}{dt} = D_1 \cdot \frac{d^2 C_i}{dx^2} C_i$$

Mass balances, partitioning

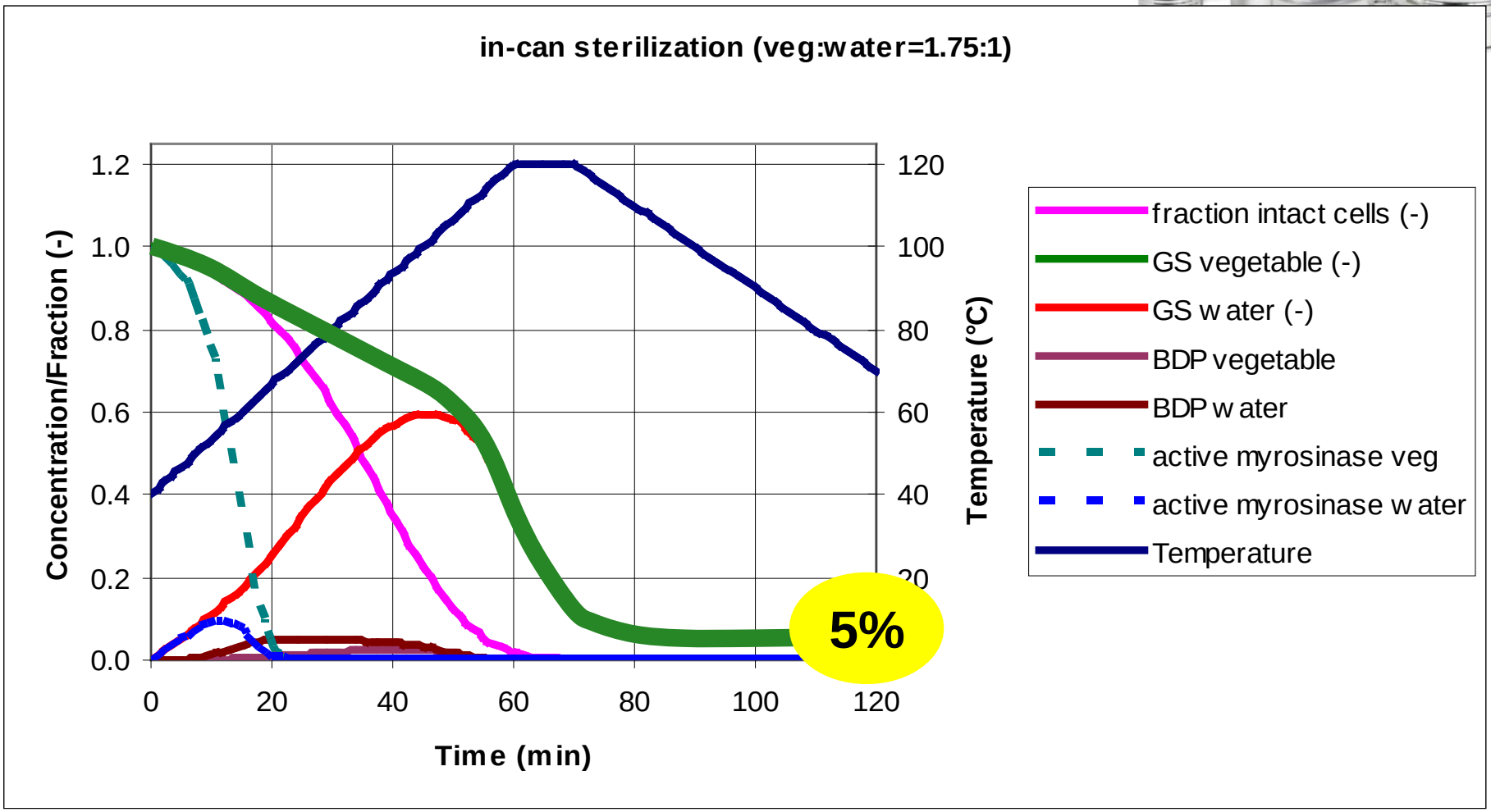
$$M_1 \cdot C_{i1,\,t=0} = M_1 \cdot C_{i1,\,t=1} + M_2 \cdot C_{i2,\,t=1};$$

$$\frac{C_{i1}^{\infty}}{C_{i2}^{\infty}} = P_{1/2}$$

Effect of processing conditions

$$k_d = k_{d,ref} \cdot e^{\frac{E_a}{R} \cdot \left(\frac{1}{T} - \frac{1}{T_{ref}} \right)}$$

Process Simulation



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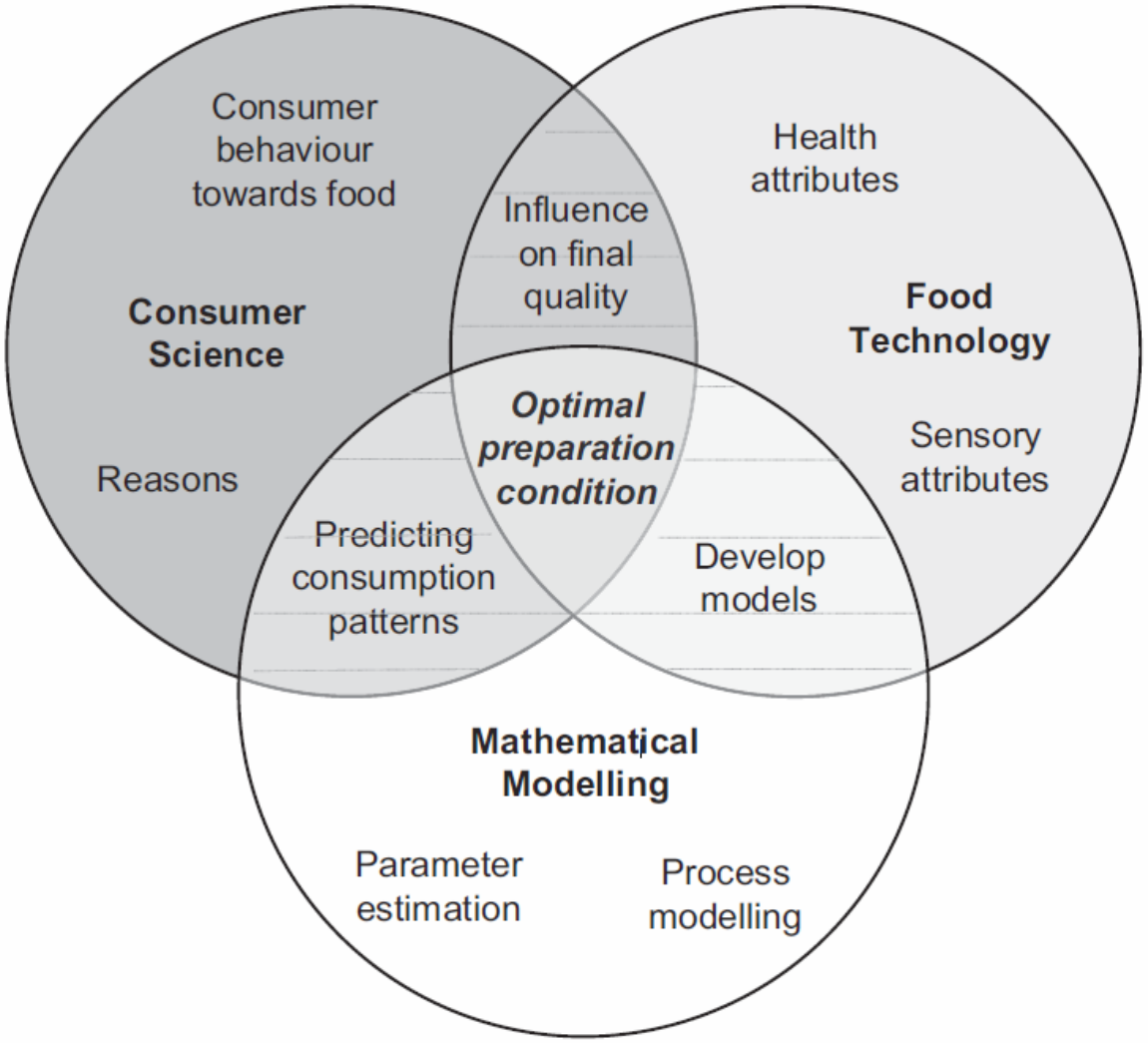
QACCP-3: Consumer Aspects



PhD project Radhika Bongoni

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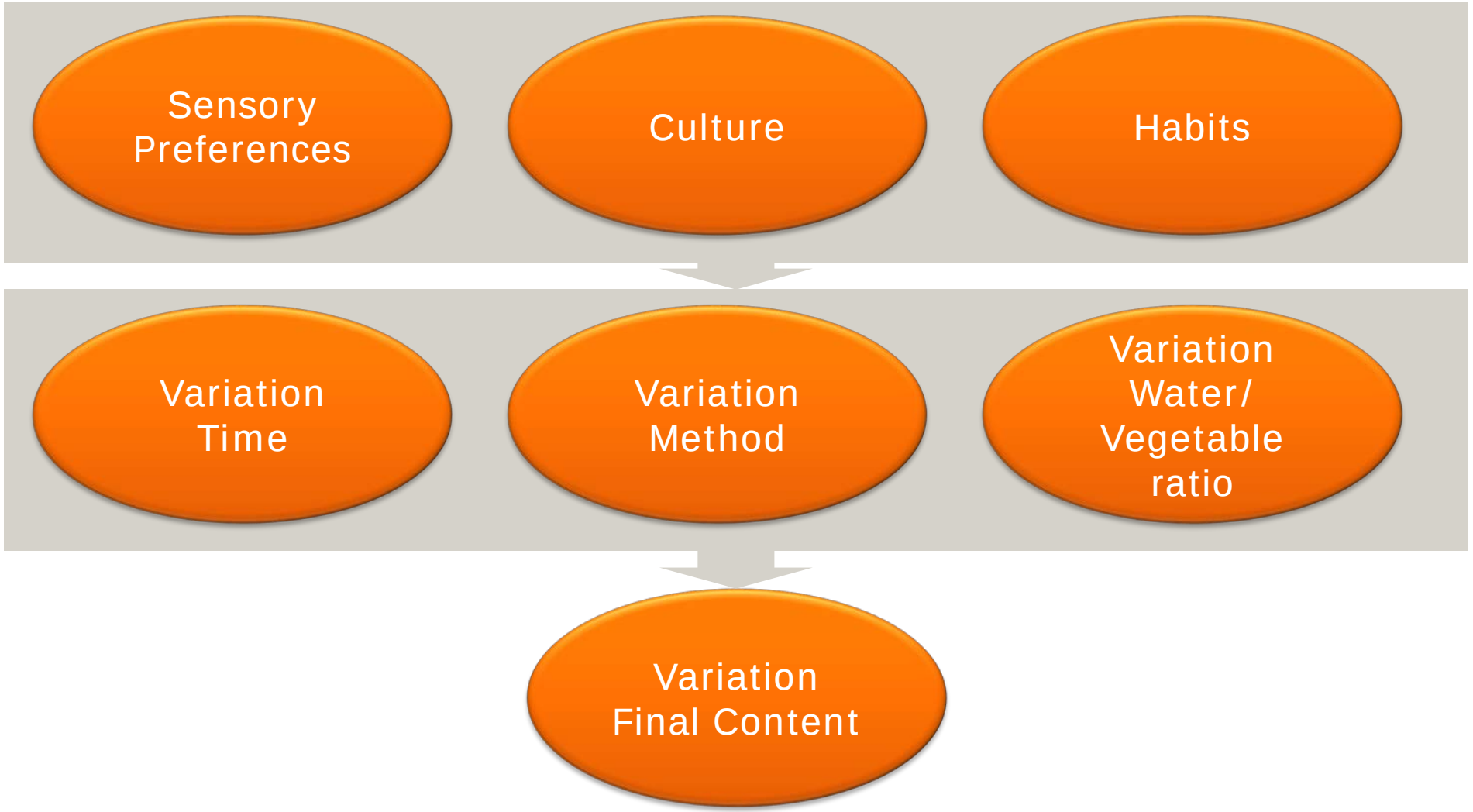
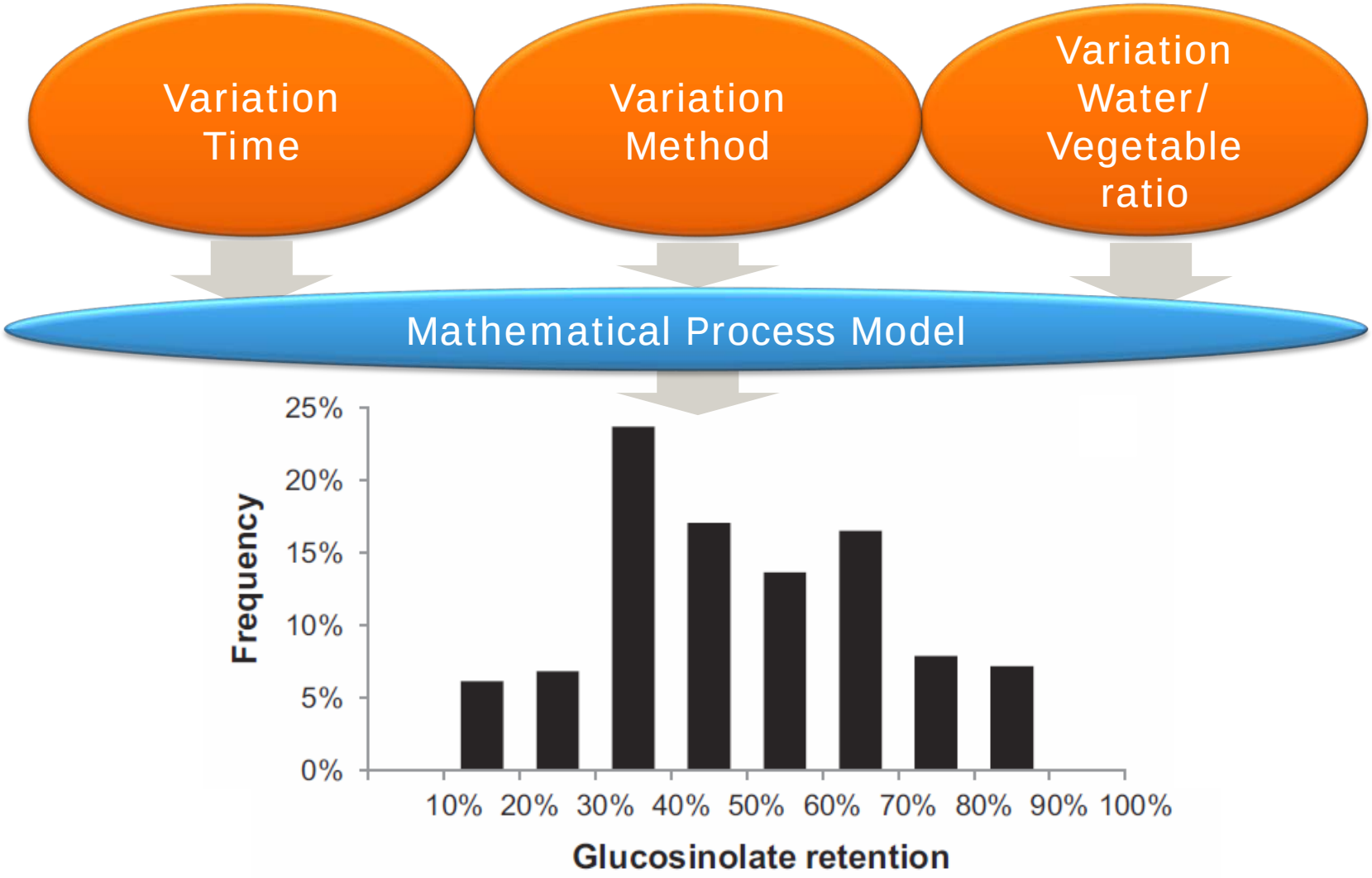
Consumer Aspects



Consumer Aspects



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Promotie

Pasta highly enriched with vegetables: from microstructure to sensory and nutritional aspects

With increasing numbers of childhood obesity, new strategies are needed to tackle this problem. A possible strategy is the incorporation of vegetables, usually disliked by children, into a food they do like, such as pasta. This research focused on the understanding on how high amounts of added broccoli affect the microstructure of pasta and noodles and how this is related to textural properties.

Promovendus	EM (Elisabete) Vicente da Silva
Promotor	prof.dr. E (Erik) van der Linden
Copromotor	dr.ir. LMC (Leonard) Sagis dr. E (Elke) Scholten dr.ir. M (Matthijs) Dekker

Contactpersoon
EM (Elisabete) Vicente da Silva
Contactformulier

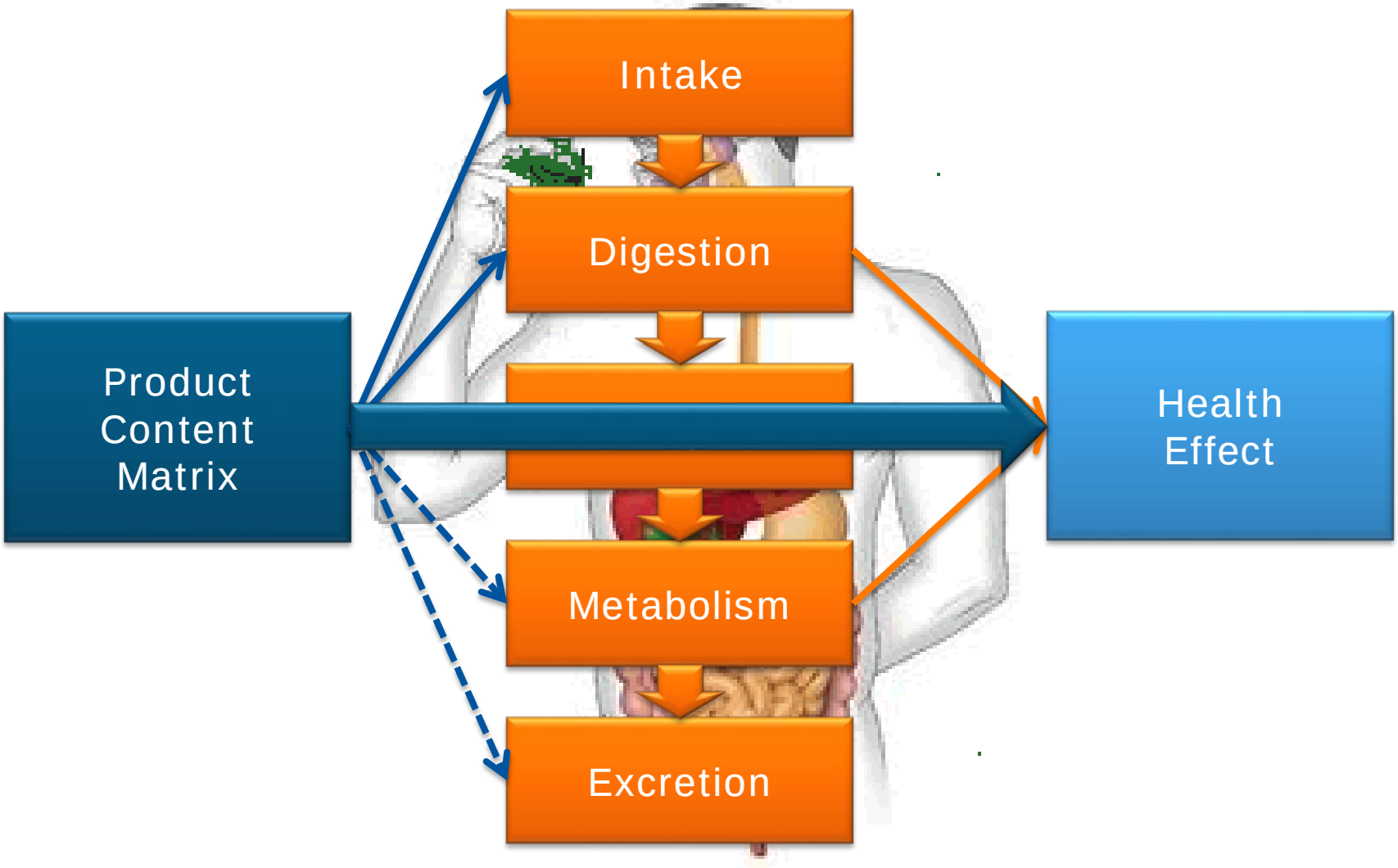
More information

- Live broadcast of the PhD defence
- Missed the broadcasting?

Continue to

PhD project Elisabete Silva

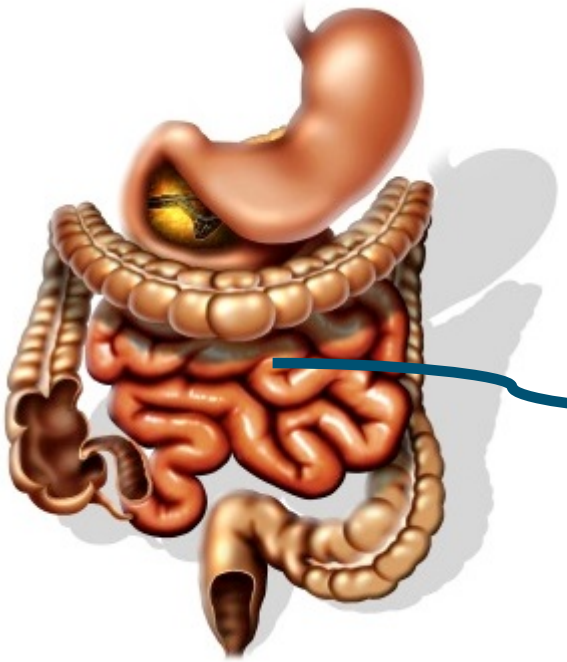
Future Prospects for Foods for Health



Future prospects: Modelling Example

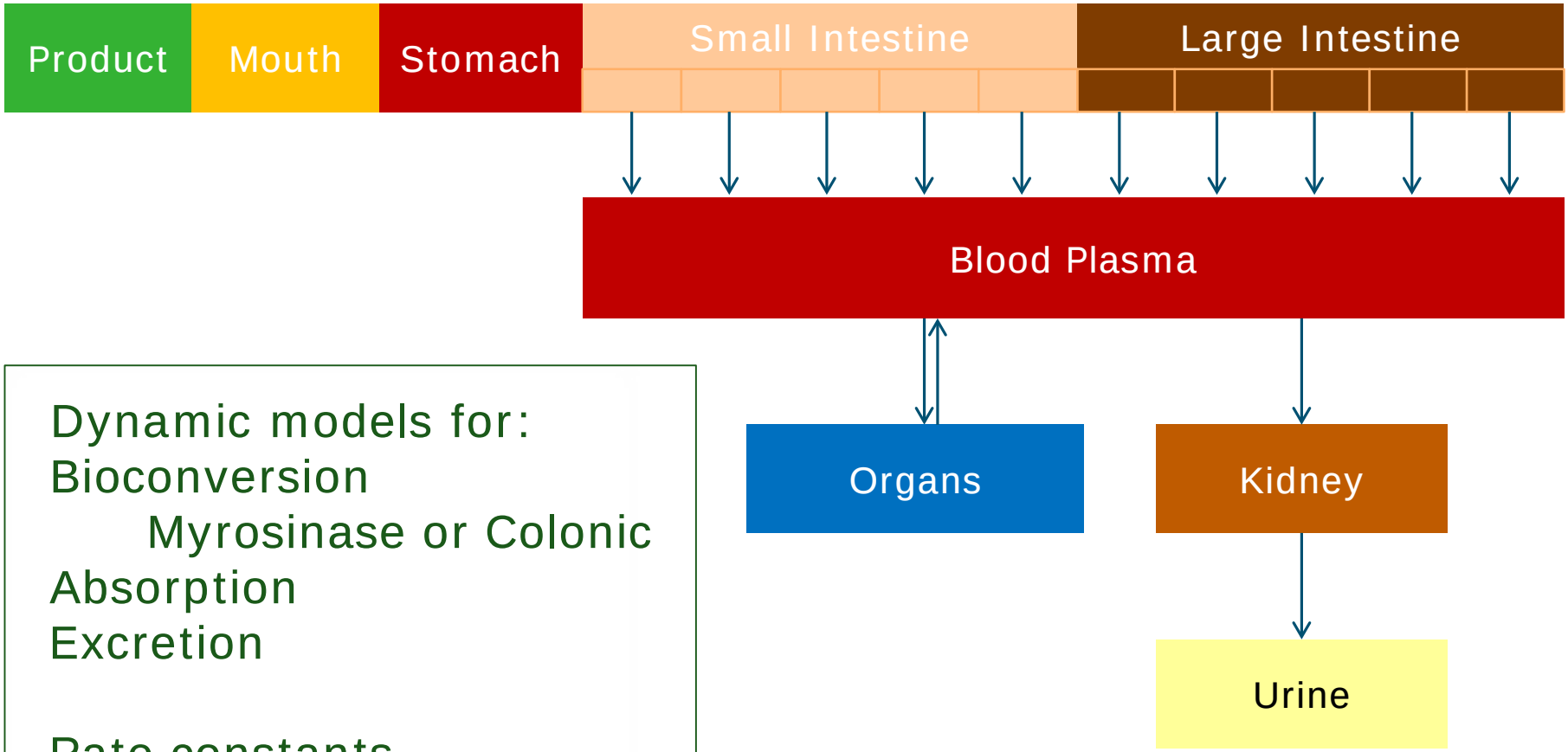
GSs content
ITC content
MYR activity

Processing conditions



Bioconversion
Bioavailability
Metabolism
Excretion

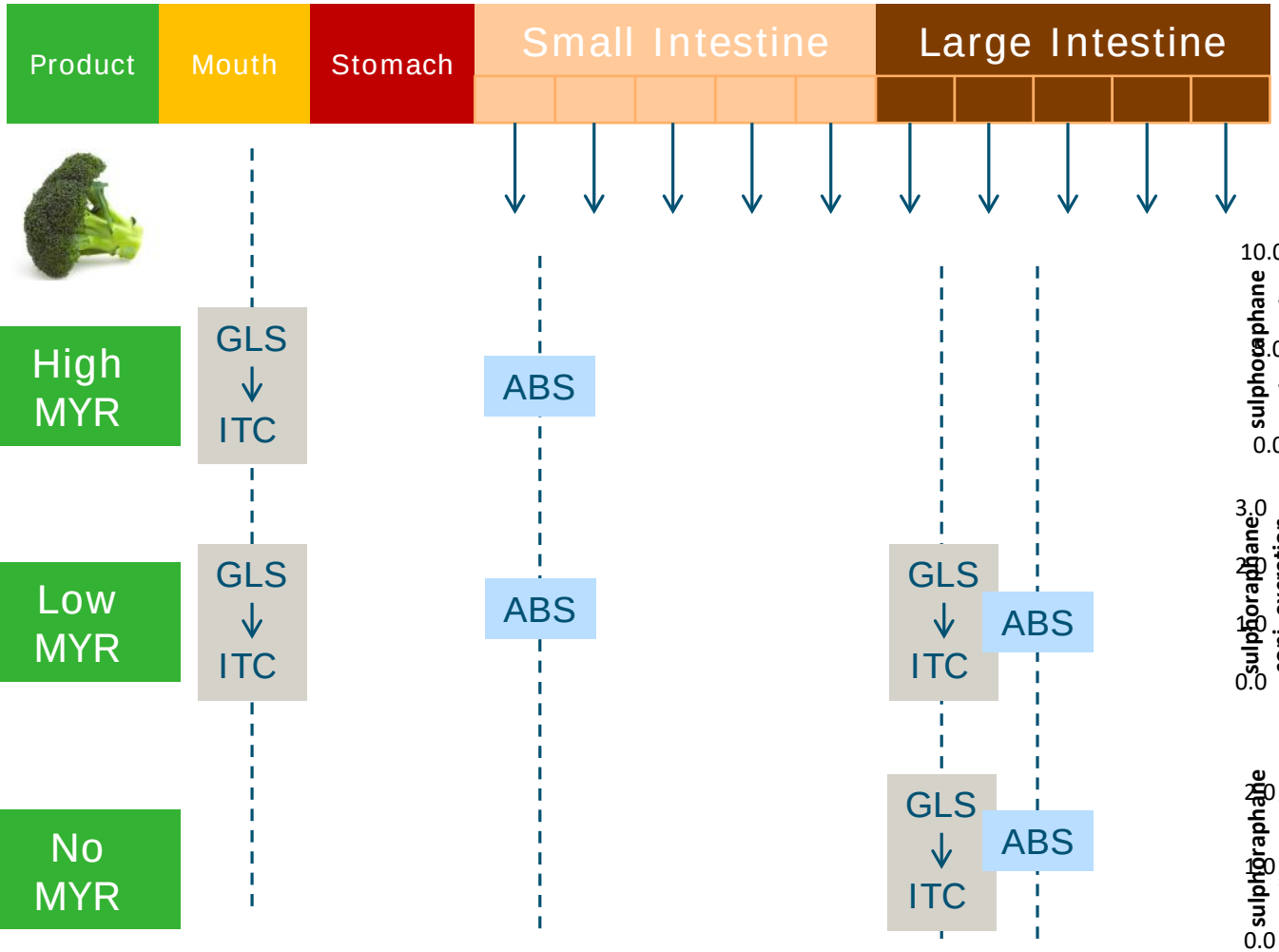
Future prospects: Modelling Example

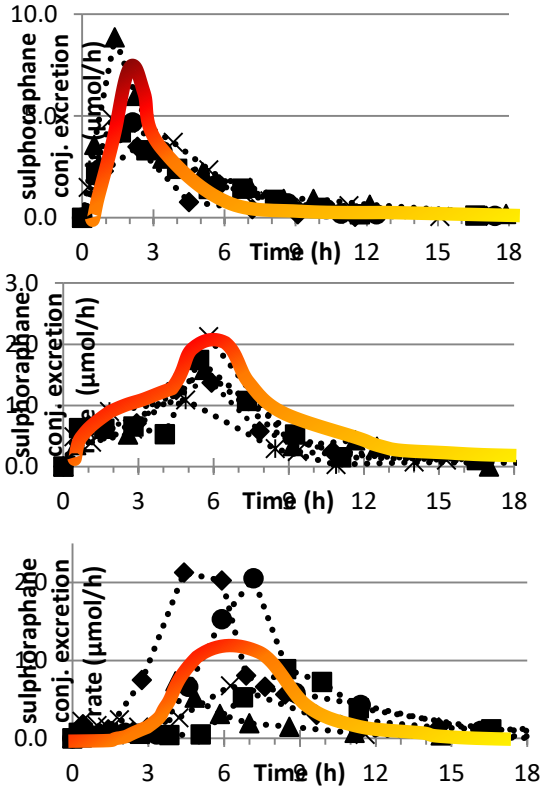


Dynamic models for:
Bioconversion
Myrosinase or Colonic
Absorption
Excretion

Rate constants
Transit times

Future prospects: Modelling Example





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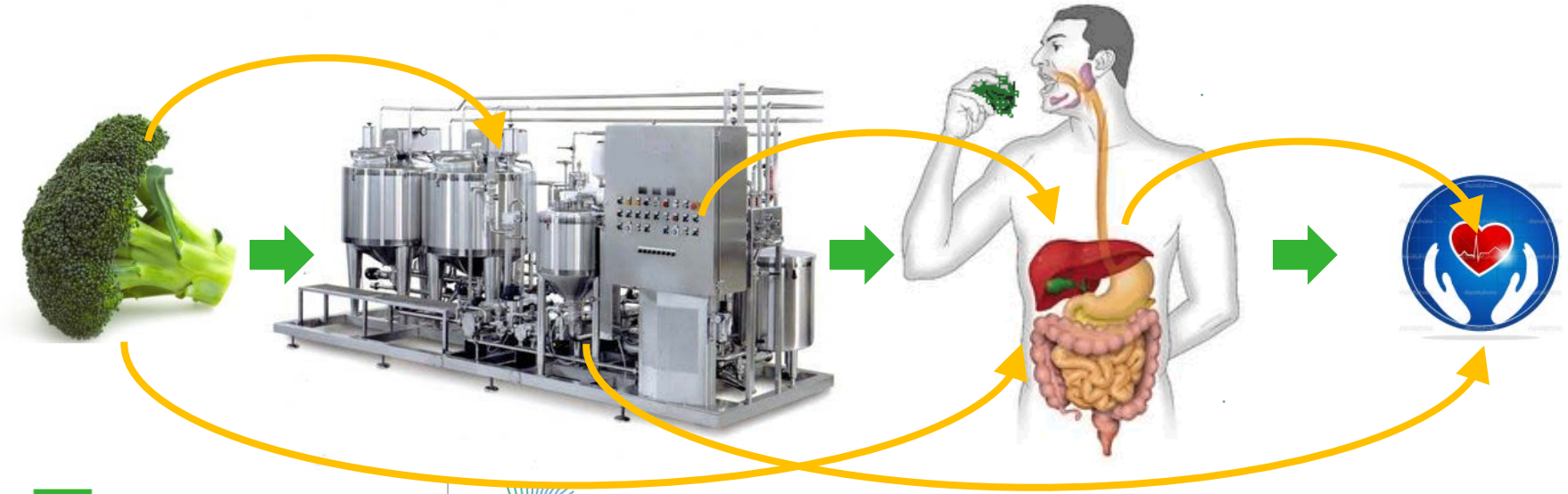
PhD project: Teresa Oliviero

Linking Food Science and Nutrition

- Linking product properties to physiological effects
  - Linking process conditions to product properties
  - Linking product properties to physiological parameters
  - Linking physiological parameters to health benefits



Quantifying the potential…

- Intake of F&V is associated with h enefits
- Phytochemicals in F&V show he enefits
- Phytochemicals content F&V iable
- Intake phytochemicals will be e
- Still association between intake th is found!

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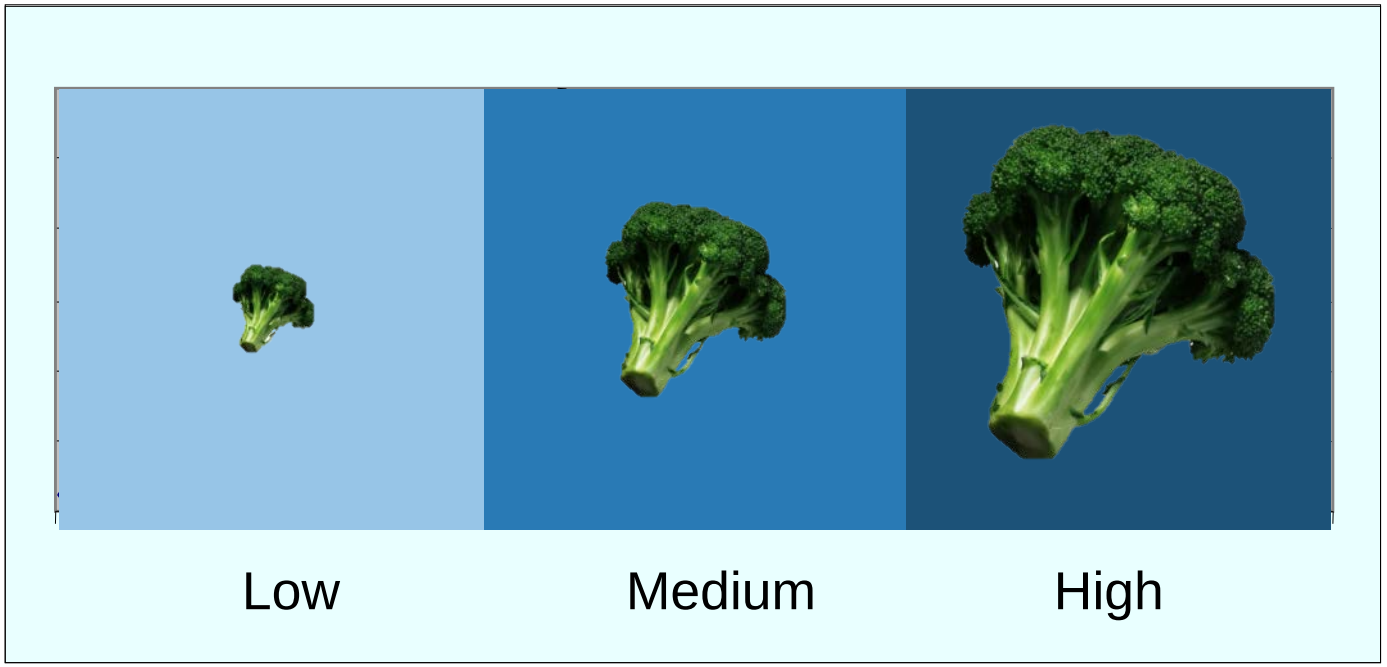
Monte Carlo Simulation of intake:

- **Simulated intake of glucosinolates**



Protective effect simulation

Effects on colon cancer cases:

- # of new cases, yearly per 10,000 inhabitants

Scenario:	Cases	
Reference situation		
Product intake +50%		-12%
Mean 3-fold↑, SD 3-fold↓		-47%!

It's just a model!!!

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Take home messages

- Potential for Food Design for Health
- Variability in supply chain enormous
- Many targets for improvement
- Modelling is a valuable tool
- Integration Food Science with Nutrition!!

- Broccoli is just an example
  - Application to other F&V chains
  - To other foods categories

“Plant Foods” group:

Probo Nugrahedi
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Thank you

Questions?

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