

HIGH-VALUE  
NUTRITION

Ko Ngā Kai  
Whai Painga

# NUTRITIONAL SCIENCE FUELLING INNOVATION

High-Value Nutrition NZ Conference 2017

## From Projects to “Systems Nutrition”

Martin Kussmann, PhD

Professor, The Liggins Institute, The University of Auckland

Chief Scientist HVN

Host Institution



- TOFI – Early Diabetes
- Kiwifruits for Glucose Control

## Metabolic Health

- Protection against Pollution
  - Natural Milk for Allergy Mgmt.

## Immune Health

- Combined Proteins for Muscle Health
- Green-Shell Mussels for Joint Health
- Grass-fed Beef for Cardiovascular Health

## Infant Health

- Complementary Feeding for Protection
- Fibres for Baby Sleep

## Digestive Health

- IBS Elite Gut
- A2  $\beta$ -Casein Milk for GI Comfort

- Food Bioactives
- Asian Consumers
- IP, Retail, Regulatory

# HVN 1.0

National  
**Science**  
Challenges

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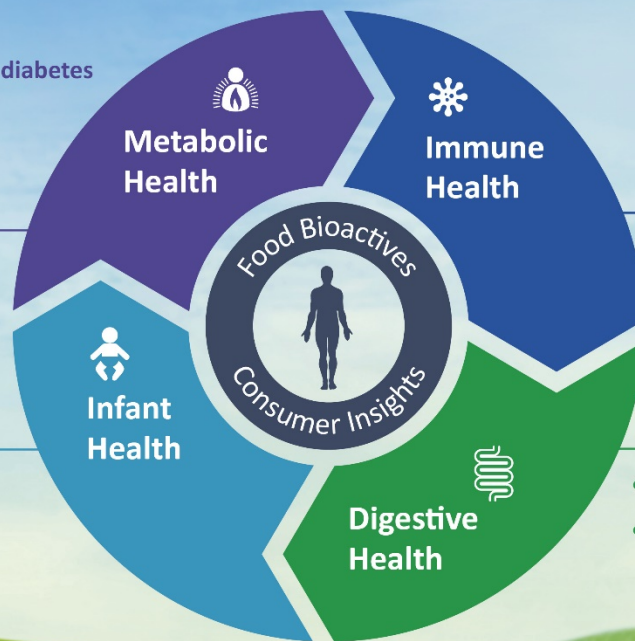
# High-Value Nutrition National Science Challenge

## research themes and projects

- TOFI: Thin on the outside, fat inside: preventing diabetes
- Kiwifruit for glucose control
- Combined proteins for lean body mass
- Grass-fed beef for cholesterol control

### Immunity & Metabolism Human Microbiome Systems Nutrition

- Complementary feeding for immune protection
- Fibres for sustained energy release



- Building immune defence
- Natural milk for allergy management
- Greenshell™ mussels to manage inflamed joints

### Food Bioactives Asian Consumers

- Characterising irritable bowel syndrome
- A2 Milk for gut comfort

# HVN 2.0

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## Our whole systems approach to High-Value Nutrition science



Our research focuses on understanding biological processes as complex integrated systems.  
Nutrition to keep us healthy and well requires an holistic approach.



# Systems Nutrition\* in and with partners



NEW INSIGHTS

**HVN: Metabolic, Immune, Gut & Infant Health**

**BIOLOGY**

NEW  
HYPOTHESES

NEW  
BIOLOGICAL  
QUESTIONS

**TECHNOLOGY**

NEW TECHNOLOGIES

NEW  
DATA

**COMPUTATION**

NEW  
SOFTWARE



COSBI

**UPMC**  
SORBONNE UNIVERSITÉS

**Data Science**



© Institute for  
Systems Biology



**Clinical Omics**



<https://www.systemsbiology.org/about/what-is-systems-biology/>

\* © Jim Kaput, Vydiant, CA, USA. Kussmann, Kaput Frontiers 2013

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# Systems Nutrition in Infant Health

## Impact of breast-feeding and high- and low-protein formula on the metabolism and growth of infants from overweight and obese mothers

François-Pierre J. Martin<sup>1</sup>, Sofia Moco<sup>2</sup>, Ivan Montoliu<sup>3</sup>, Sebastiano Collino<sup>1</sup>, Laetitia Da Silva<sup>1</sup>, Serge Rezzi<sup>1</sup>, Ruth Prieto<sup>4</sup>, Martin Kussmann<sup>1,5,6</sup>, Jaime Inostroza<sup>7</sup> and Philippe Steenhout<sup>8</sup>



Breast  
feeding



Formula  
feeding

### Carbohydrate metabolism

↑ Lactate (stool)  
↑ Milk oligosaccharides (stool)

### Growth and development

↑ IGF-1

### Protein metabolism

↑ Protein-derived SCFAs (stool)  
↑ Urea cycle and nitrogen balance

### Energy metabolism

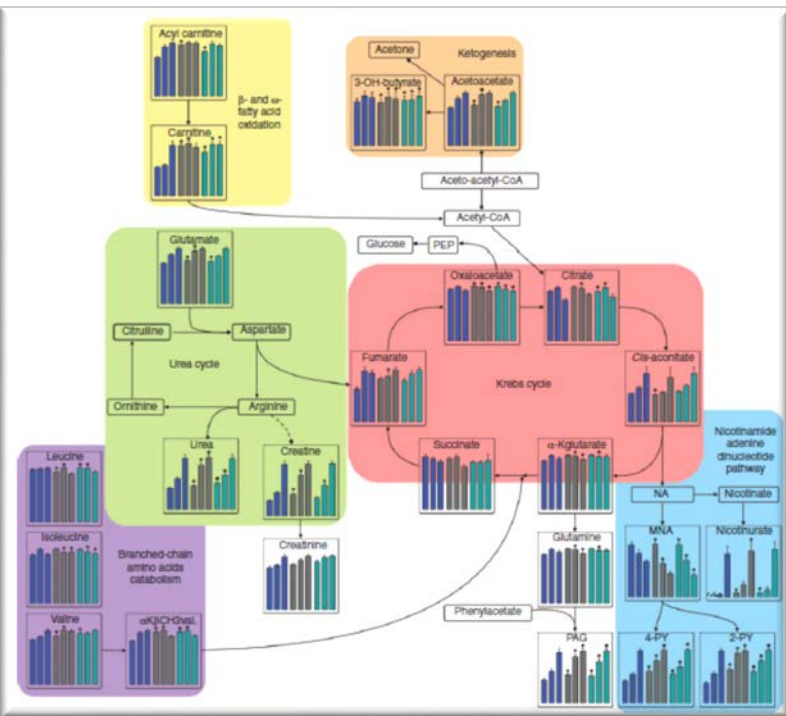
Different Krebs cycle and NAD/NADP metabolic pathways

### Lipid metabolism

Ketogenesis (milk lipids)

### Lipid metabolism

↑  $\beta$ -oxidation (carnitine)  
↑ Ketogenesis (lipids and ketogenic AAs)



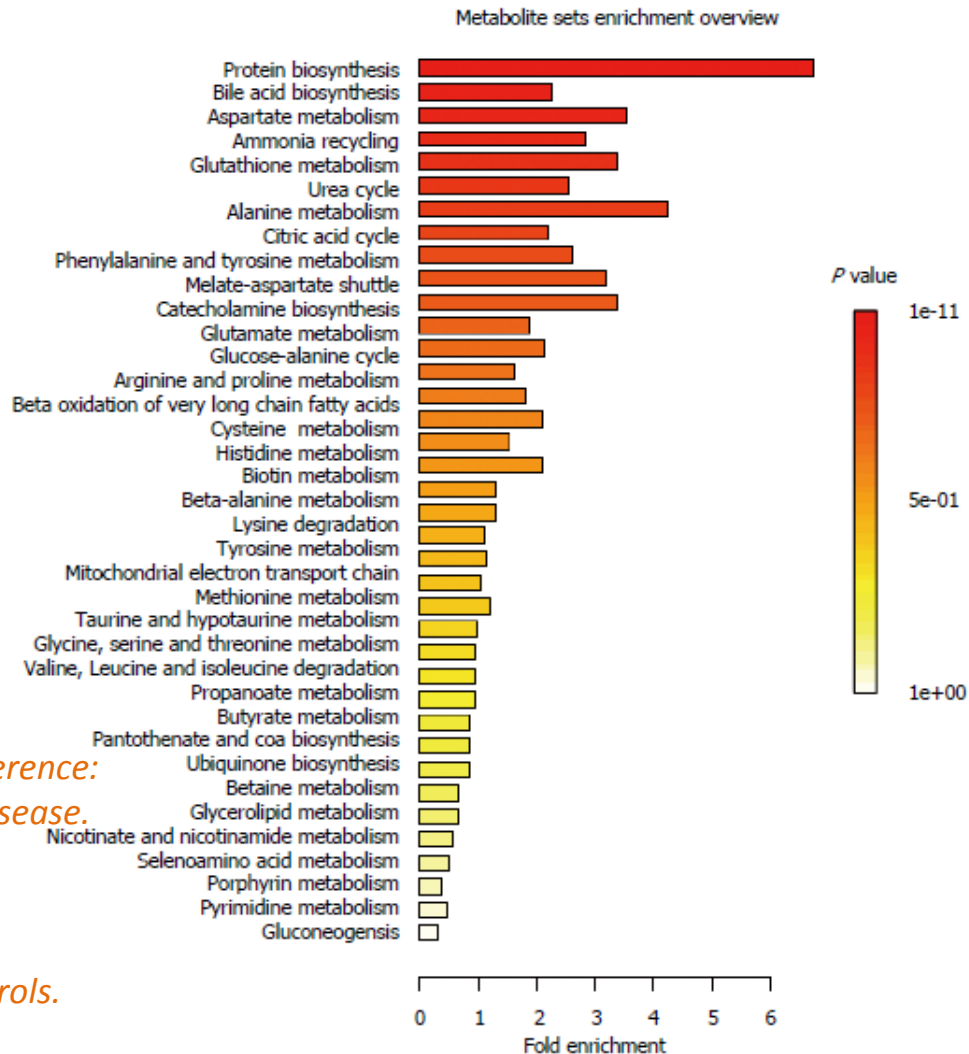
## Basic Study

## Systems Nutr

# Urinary metabolic insights in IBD interactions in healthy and IBD

Francois-Pierre Martin, Ming-Ming Su, Guo-Xiang Xie, Wei Jia, Andreas Nydegger

- Non-invasive **urine sampling plus metabolomics** elucidates metabolism of children with different GI health/disease status.
- **Few subjects, but longitudinal design** with healthy reference: childhood metabolism related to growth, health and disease.
- Molecular profiles show **nutritional requirements in IBD children.**
- Metabolism of **glutathione, glycine and bile acid** distinguished IBD children from healthy matched controls.

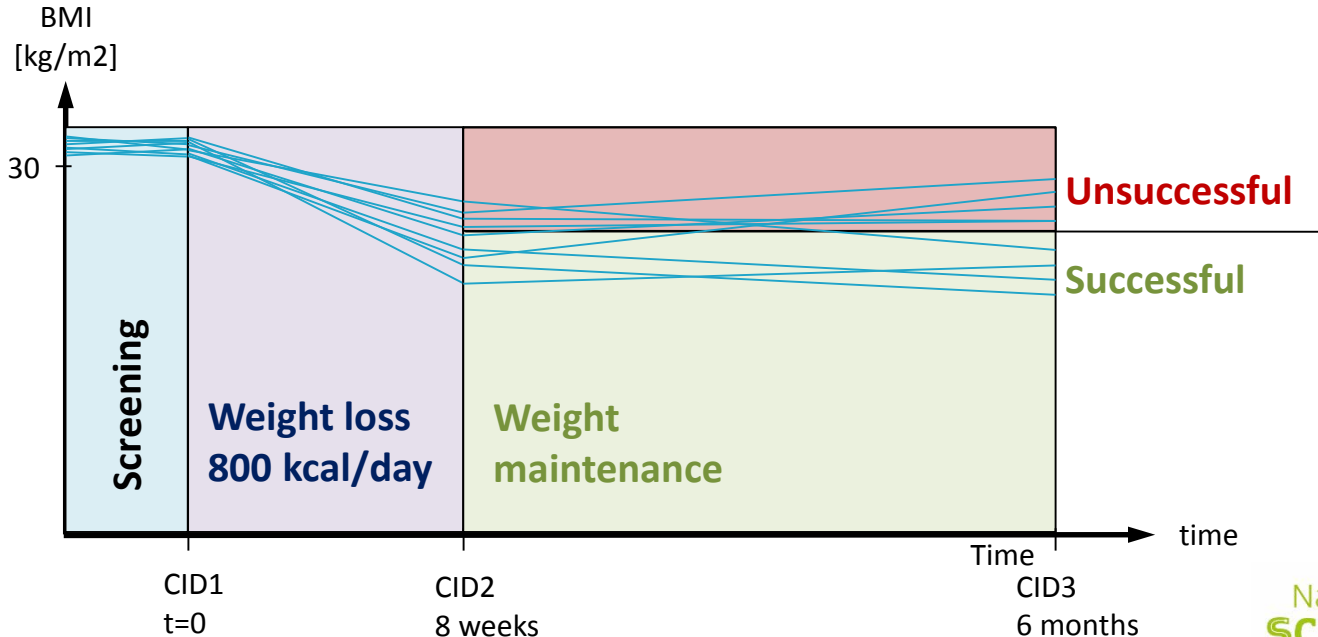


# Systems Nutrition in Metabolic Health

- EU program on weight loss/maintenance in obese

- Question:

**Can we predict success in weight loss/maintenance at baseline ?**



≈ 1'000 subjects  
> 4'000 samples  
> 7'000 variables  
(clinical, food diaries,  
behavior, molecular)

[www.diogenes-eu.org](http://www.diogenes-eu.org)

Rubio-Aliaga...Kussmann, MNFR 2011. Cominetti, Dayon...Kussmann PCA 2017. Larsen et al. NEJM 2010

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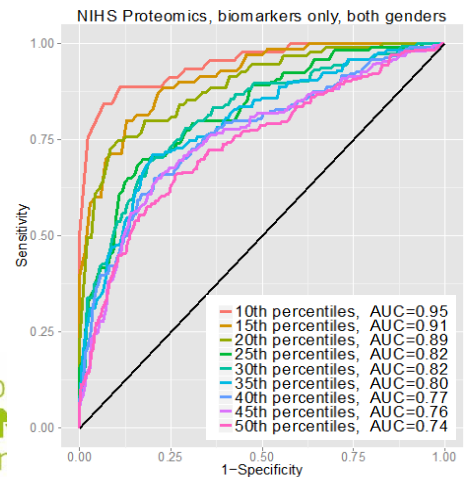
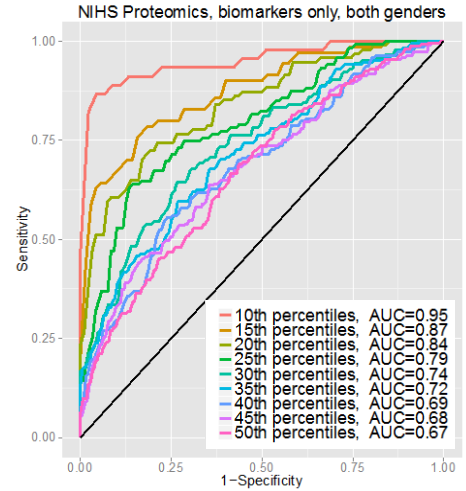
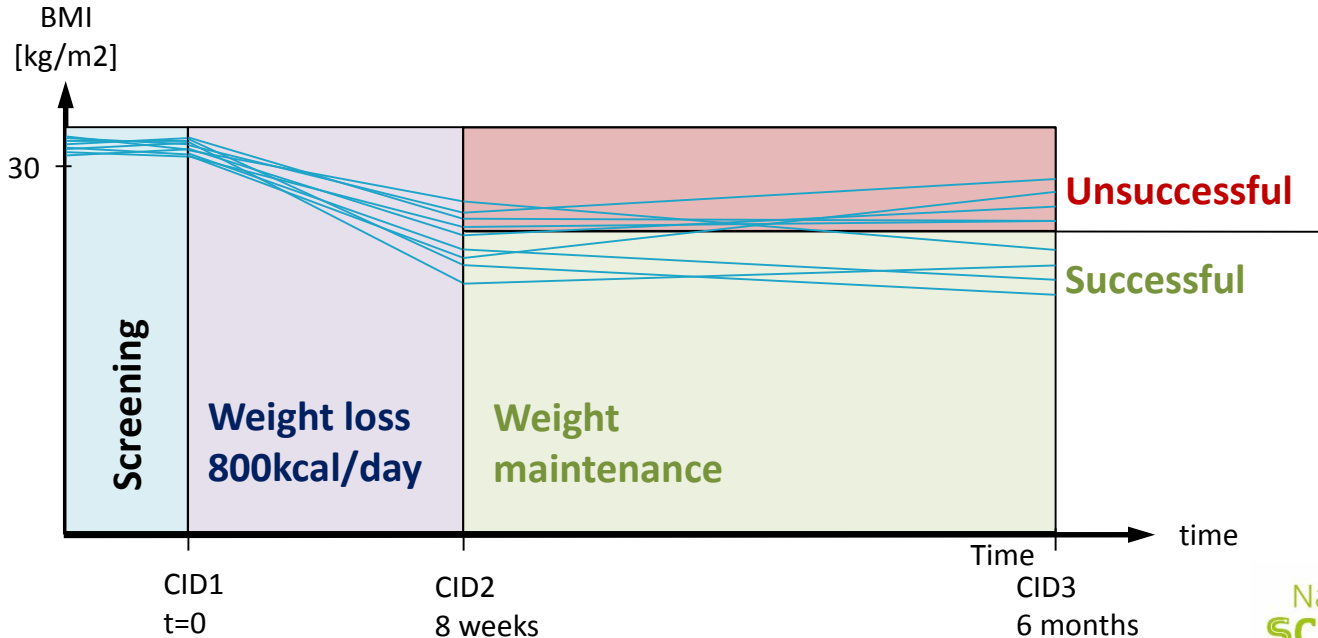


# Systems Nutrition in Metabolic

- EU program on weight loss/maintenance in obese

- Answer:

Yes, we can predict success in weight loss/maintenance at baseline !



# Systems Nutrition in HVN

- We deploy **omics** for comprehensive characterisation of human conditions: **Infant, Immune, Metabolic & Digestive Health**, all related to **metabolism** and **immunity**.
- We identify **biomarkers** to classify **disease subtypes** (IBS, TOFI).
- We consider **gene x environment interactions**:  
We study **Asians** and their **environment**.
- We study the **microbiome** as the ecosystem that connects diet to **personal health**.
- **Maori holistic health** meets **Systems Nutrition**



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**Identifying and Mitigating Errors in  
Nutritional Science**

**Nourishing the Immune System and  
Preventing Disease**

**The Science of the Human Microbiome**

**Building the Foundation: Procurement of  
Relevant Measures and Big Data Analysis**

(Martin Kussmann, Josep Bassaganya-Riera, Raquel Hontecillas, Tapan Mehta, and Chor San H. Khoo)



CrossMark

n Mehta) 015–2020

urlingame<sup>6,7</sup>,  
Jackson<sup>11</sup>, Willem van Eden<sup>12</sup>,  
ch Knorr<sup>15</sup>,  
rian Meule<sup>20</sup>,

# Thank You !



## We are all different and not alone !

