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The Design and Development of an Automated Glycemic Index Analyser

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Glycemic Index: Health Issues

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Glycemic Index of the foods we eat is important for the following reasons:

1. Diebetes - the control of blood glucose and Insulin
2. Obesity - appetite control, appetite suppression
3. Children - energy and obesity
4. Heart Disease - weight control
5. Colon Rectal & Bowel Cancer
   - efficient gastric flow

Glycemic Index Analysis

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- Glycemic Index measures the release of glucose from food under enzymatic digestion.
- GI relates mostly to foods that contain measureable levels of carbohydrates: cereals, dairy, baked goods, energy bars, etc
- Glucose has a GI of 100
- GI ranges from:
  - High GI: > 70
  - Medium GI: 55-69
  - Low GI: < 55

Glycemic Index Analysis

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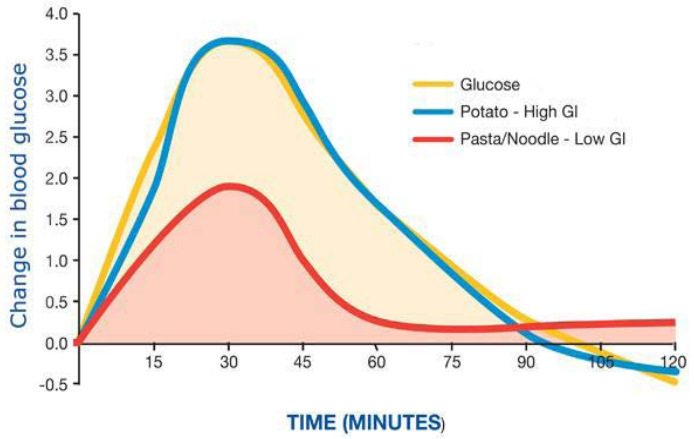
•Gold Standard In Vivo Method

-10 subjects -12 hour fast,
no exercise

- Eat 50 g of food sample

- Blood glucose measured each 15mins for 2 hours

- 3 tests: 1 glucose reference
2 repeat tests for food samples



- Area under the curve is the Glycemic Response - GR

- GI = 100* (GR for 50g of food/GR for 50g of Glucose)

NutriScan GI and RS Analysers

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Developed by CSIRO, Div of Food and Nutrition Sciences

- **GI = Glycemic Index**
- **RS = Resistant Starch**
- **1st in the world**
- **Artificial Gut to simulate the digestion of food and to measure the glucose released over :**

  5hr (GI Analysis) and

  16hr(RS Analysis) period.

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NutriScan GI and RS Analysers

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- The system involves a series of incubations, at physiological pH and temperature that essentially mimic the buccal, gastric and pancreatic phases of digestion.
- Intended for use in Research into Animal and Human Nutritional.
- Intended not as Replacement for In Vivo method.
- Intended for Product Development and QC

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NutriScan GI20 Analysers

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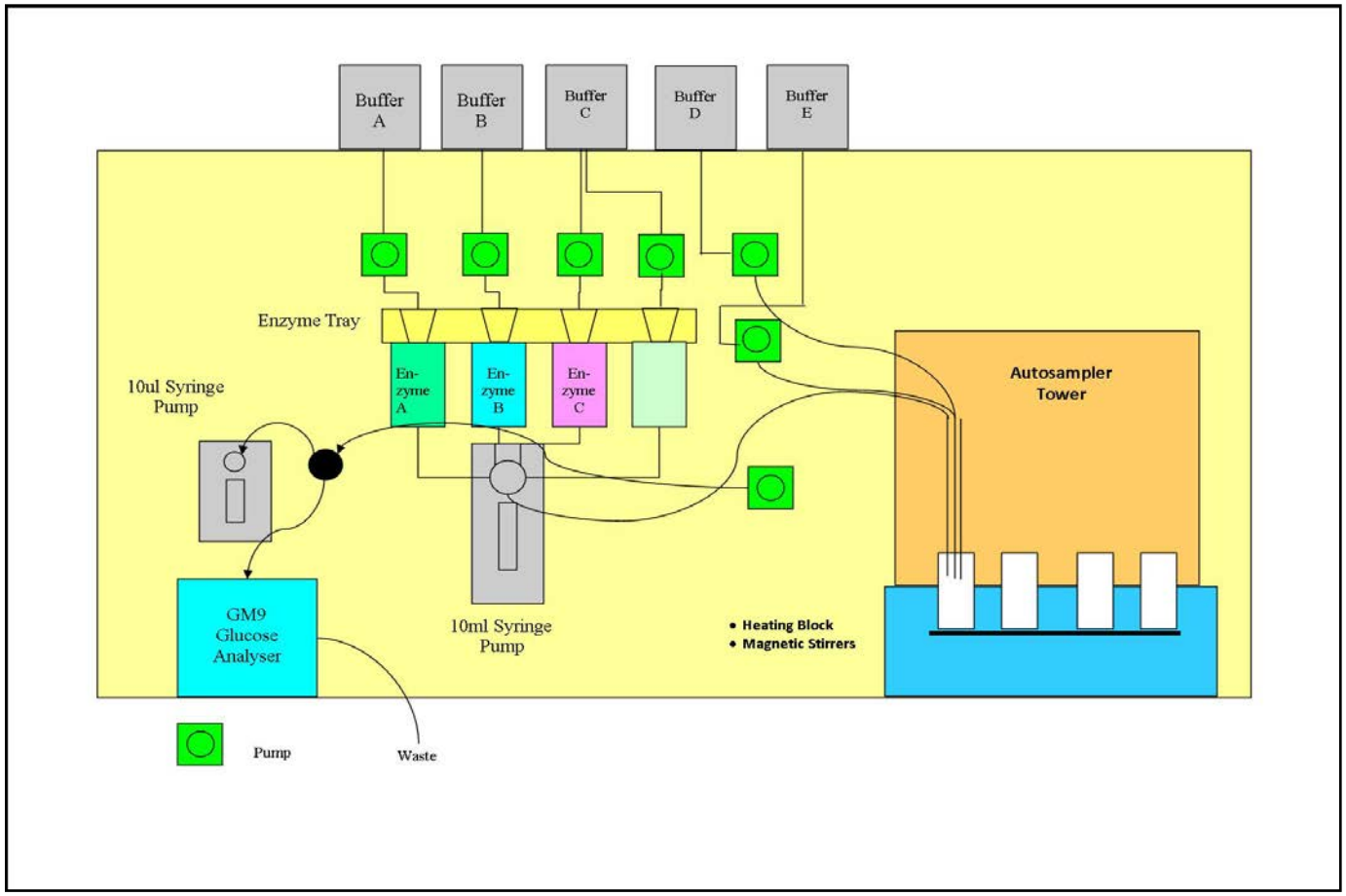

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NutriScan GI20 Analysers

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Pre-weighed Enzyme Cartridge

- 5, 10 and 20 sample cartridges
- Ensures consistency of results against the validation studies performed by CSIRO
- Reduces errors due to weighing

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Pumping System

- 4 peristaltic pumps
  - 1 x 3 head pump loads enzyme bottles
  - 2 single heads pumps load other buffers
  - 1 single withdraws samples from digest.
- 2 syringe pumps
  - 10ml syringe dispenses enzyme solutions
  - 500ul syringe injects 10ul sample into GM9

NutriScan GI20 Analysers

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20 Cup Digester

- XYZ Rotary Dispensing System
- Fully programmable
- Gentle Agitation :
  20 position magnetic stirrer block
- Temperature controlled heating block: 37C

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Glucose Analyser

- Glucose Oxidase Reaction

$$\text{Glucose} + O_2 \xrightarrow{\text{GOD}} \text{Gluconic Acid} + H_2O_2$$

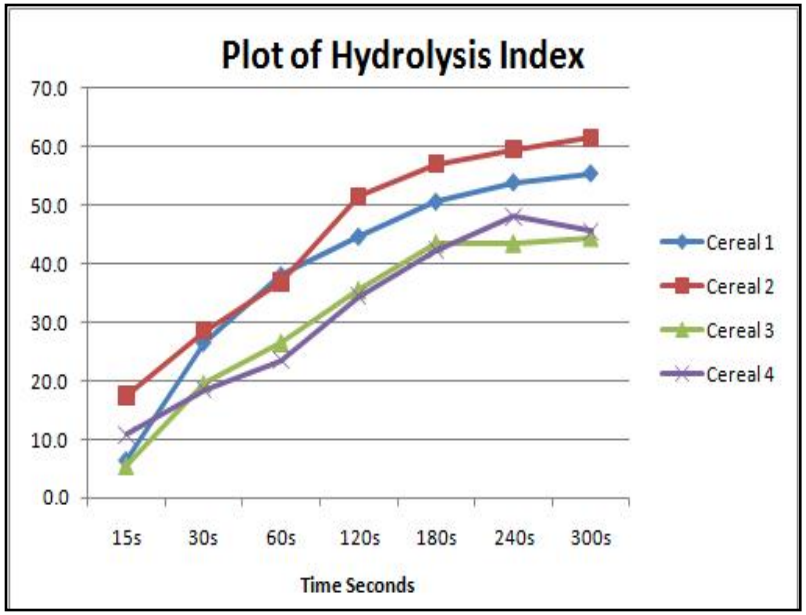
- Measures the depletion of Oxygen using an Oxygen Electrode
- RS232 coms to external PC

NutriScan GI20 Analysers

NutriScan

PC Controlled

- Fully programmable
- Program
  - Enzyme sequencing
  - Incubation times
  - Sampling times
  - Buffer loading volumes and sequences.
- Automatic data report
  - Plots Glycemic Load, Hydrolysis Index
  - Reports GI



NutriScan GI20 Analysers

Comparison between the In Vivo GI and RS VS the In Vitro methods:

Parameter	In Vivo Method		In Vitro Methods	
	GI	RS	GI	RS
Time required To produce results	7 days	24 days	1 day	1 day
Cost per test	$4000	$8000	$25-100	$25-100
Sample throughput (Runs per week)	2	1-2	100-200	50
Discrimatory Power	15GI units	0.5g RS/g food	5 GI units	0.2g RS/g food
Inter Assay Precision CV²	30-40%	20-45%	2-10%	5-20%

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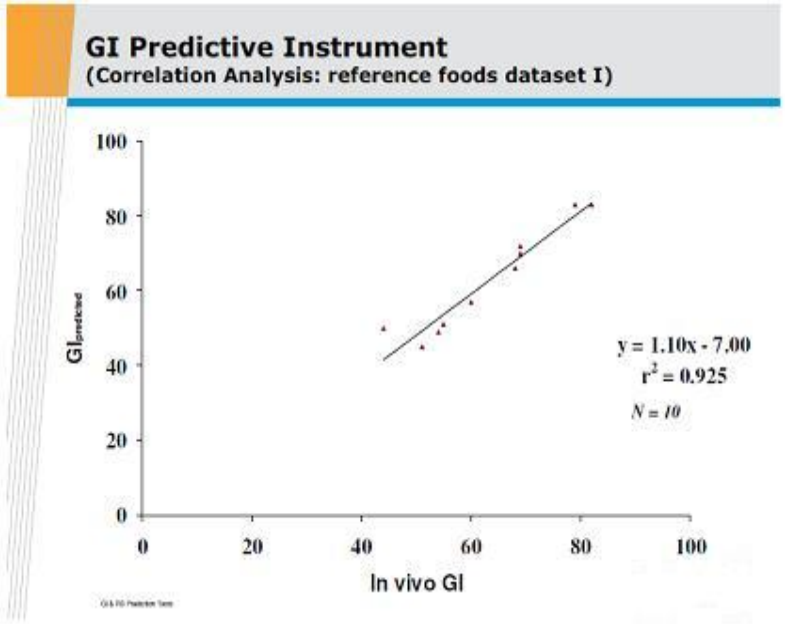
CSIRO Food and Nutrition Sciences have analysed hundreds of foods using their GI and RS Analysers and compared the results with the In Vivo Methods.

Sample Type	GIValue	CV%
Shortbread Biscuit	69	3.4
Graham Cracker	83	2.7
Savoury Cracker	80	3.8
Breakfast Cereal 1	82	4.9
Breakfast Cereal 2	52	2.3
Breakfast Cereal 3	65	2.7
Snack Food	75	4.4
Fruit Bar	44	10.9
White Bread	82	3.8
Wholemeal Bread	74	2.7



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Resistant Starch is the starch that passes through to the small intestines without undergoing enzymatic digestion.

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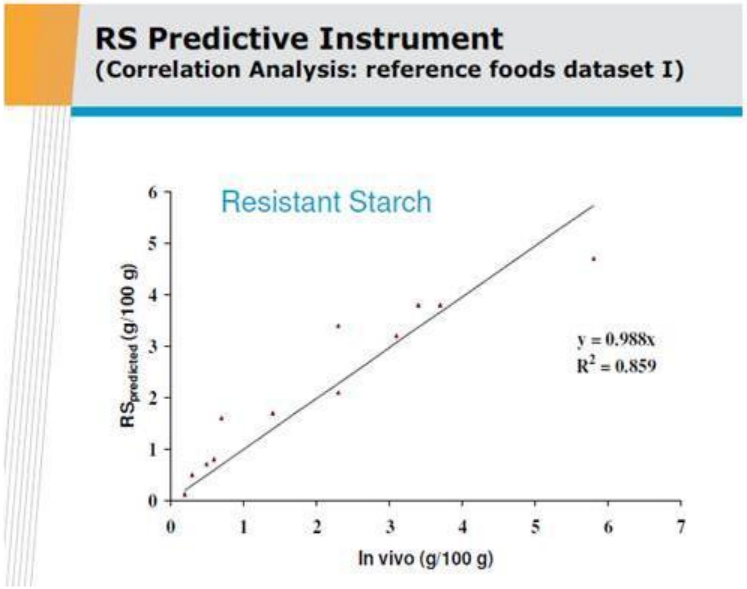
Sample Type	RSValue s
Pasta	.5-1.0%
Breakfast Cereals	.2-3.0%
Bread - Wholegrain	1.5-2.5%
Bread - White	.5-1.0%
Potato - Fries	1.0-1.5%
- Powdered	.3%
Pasteries	.3-.9%
Legumes	2.0-5.0%



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NutriScan GI20 Analysers

Summary:

NutriScan GI20 Glycemic Index Analyser

- Fully Automated Artificial Gut
- 20 Sample Capacity
- Improved Precision vs In Vivo Method
- Validated by CSIRO
- Suitable for Product Development and Routine QC

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