The background of the slide is a photograph of a laboratory rack filled with numerous test tubes. The tubes are arranged in rows and have various colored caps, including purple, blue, and yellow. The image is slightly blurred, creating a soft, professional atmosphere. The text is overlaid on this background.

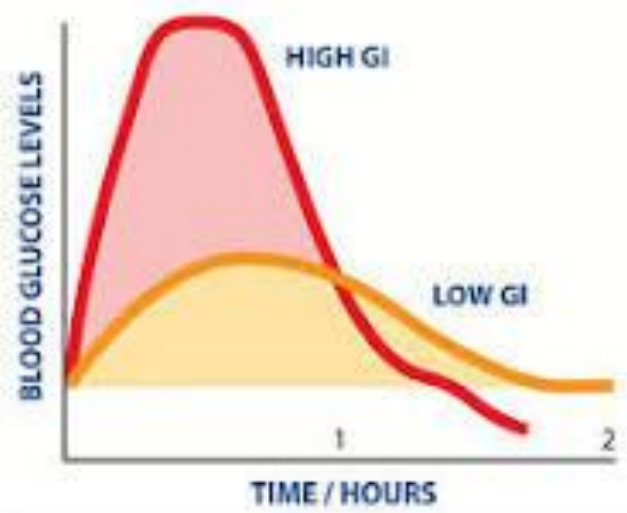
Glycemic Index and Glycemic Load in Management of Blood Glucose levels

Dr B Sesikeran MD, FAMS
Former Director
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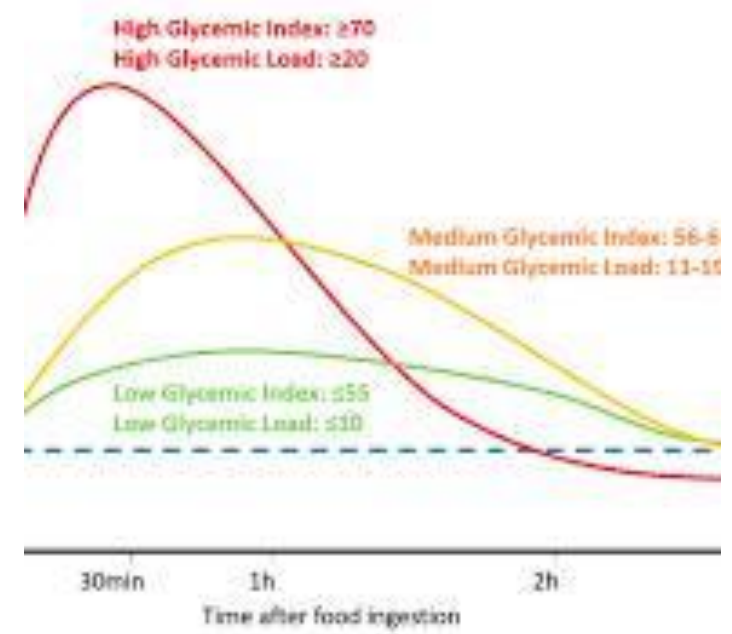
The glycemic index (GI)

- Is a measure of the blood glucose-raising potential of the carbohydrate content of a food compared to a reference food (generally pure glucose).
- Carbohydrate-containing foods can be classified as high- (≥ 70), moderate- (56-69), or low-GI (≤ 55) relative to pure glucose (GI=100).





The amount of carbohydrate in the reference and test food must be the same.





GI by composition of carbs in Foods

- Foods with simple sugars like Glucose and Fructose – High GI
- Foods with Complex Carbohydrates that digest fast- High/ Moderate
- Foods with Complex Carbs that digest slowly- Moderate/ Low GI

Calculating Whole meal GI

Meal GI = [(GI x amount of available carbohydrate)_{Food A} + (GI x amount of available carbohydrate)_{Food B} +...]/ total amount of available carbohydrate

Based on published values it gave an over estimate by 22 to 50% compared to whole meal GI

(Dodd H, Williams S, Brown R, Venn B. Calculating meal glycemic index by using measured and published food values compared with directly measured meal glycemic index. Am J Clin Nutr. 2011;94(4):992-996



Example

- A low GI Rice made into a sweet Pongal with sugar / Jaggery will still show a high post prandial plasma glucose
- A low GI rice with legumes and non starchy vegetables likely to show a lower PPG levels

Fiber more predictive than GI on Glucose levels

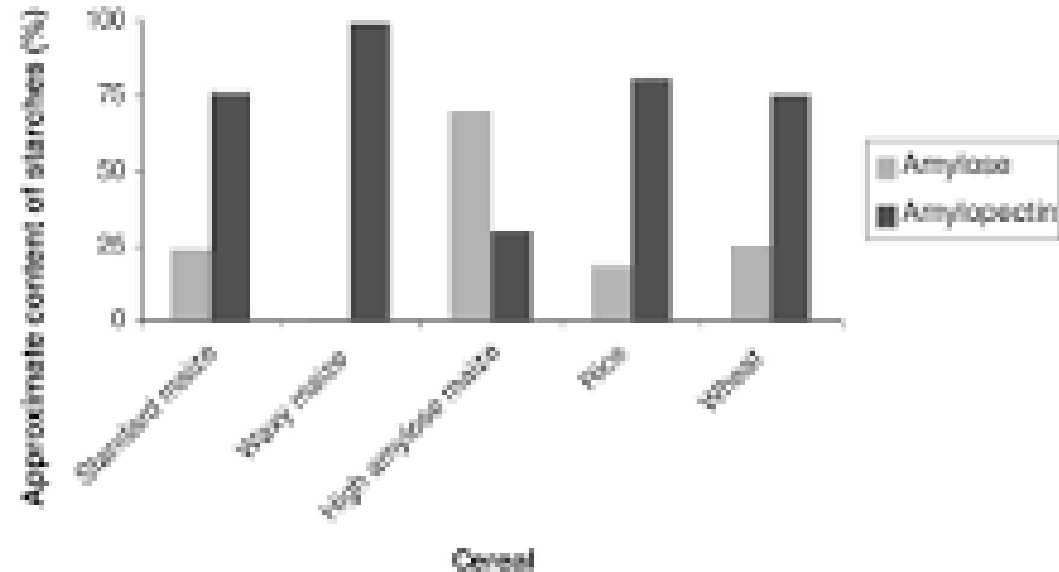
- [Plasma](#) glucose was found to be significantly higher following consumption of a high-GI and low-fiber breakfast than following a low-GI and high-fiber breakfast.

However, there was no significant difference in postprandial glycemic responses between high-GI and low-GI breakfasts of similar fiber content

(Silva FM, Kramer CK, Crispim D, Azevedo MJ. A high-glycemic index, low-fiber breakfast affects the postprandial plasma glucose, insulin, and ghrelin responses of patients with type 2 diabetes in a randomized clinical trial. J Nutr. 2015;145(4):736-741)

Total Fiber (g%) IFCT – ICMR NIN

Cereal	Total Fiber g%
Wheat flour refined (Maida)	2.76
Whole Wheat Flour (Atta)	11.36
Semolina (Sooji)	9.72
Bajra	11.5
Jowar	10.2
Quinoa	14.6
Rice Raw Brown	4.43
Rice Raw Milled	2.8



Amylose(Slow Digestible Carb) and
Amylopectin (Rapidly Digestible Carb)
content

	Amylose content (%)	Amylopectin content (%)	Amylopectin content/Amylose content
Wheat	35.54±0.23	62.17±0.32	1.75
Corn	31.88±0.14	60.27±0.55	1.89
Rice	18.68±0.14	81.28±0.30	4.35
Waxy rice	0.65±0.045	91.73±0.11	141.12
Quinoa	7.00±0.29	84.24±1.54	12.03

Values are means ± SD (n = 3)

Courtesy Dr Malleshi CFTRI



GR also affected by ...

Ethnicity

Metabolic status,

Eating habits (e.g., the degree to which we masticate),

- (Ranawana V, et al Mastication effects on the glycaemic index: impact on variability and practical implications. Eur J Clin Nutr. 2014)
- (Sun L,et al . The impact of eating methods on eating rate and glycemic response in healthy adults. Physiol Behav. 2015)



Comparison of postprandial glycaemia in Asians and Caucasians

[B S Venn](#)¹, [S M Williams](#), [J I Mann](#) Diabet Med 2010

- **Abstract**
- **Objective:** To compare postprandial glycaemic responses between Asian and Caucasian subjects.
- **Conclusions:** The findings suggest that dietary recommendations for people with diabetes and those at risk of Type 2 diabetes may be more appropriate if based on research in the ethnic group for which they are intended. **iAUC was higher in Asians than Caucasians** for the same meal



GI vs Glycemic Load (GL)

- $GL_{\text{Food}} = (GI_{\text{Food}} \times \text{amount (g) of available carbohydrate}_{\text{Food}} \text{ per serving}) / 100$
- For a typical serving of a food, GL would be considered high with $GL \geq 20$,
- intermediate with GL of 11-19,
- and low with $GL \leq 10$.
- Eg : one serving of watermelon and a medium-sized doughnut have similar GI.

GI vs Glycemic Load(GL)

- But Watermelon has a GL of 5-8, while Doughnut has a GL of 38. (Glycemic-index.net)
- Dietary GL is the sum of the GLs for all foods consumed in the diet.
- Source:Reviewed in March 2016 by:
Simin Liu, M.D., M.S., M.P.H., Sc.D.
Professor of Epidemiology, Professor of Medicine
Brown University
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Diabetes mellitus

Whether low-GI foods could improve overall blood glucose control in people with type 1 or type 2 diabetes mellitus

A meta-analysis of 19 randomized controlled trials that included 840 diabetic patients (191 with type 1 diabetes and 649 with type 2 diabetes) found that consumption of low-GI foods improved short-term and long-term control of blood glucose concentrations, reflected by significant decreases in fructosamine and glycated hemoglobin (HbA1c) levels (Wang et al 2015).

Diabetes mellitus

- Well-controlled studies are needed to further assess whether the use of low-GI/GL diets could significantly improve long-term glycemic control and the quality of life of subjects with diabetes.

GI	GL	Fiber	Blood Sugar and Risk of T2DM
high	high	low	+++
high	low	High	+/-
high	low	low	++
Low	High	Low	++
Low	Low	Low	+/-
Low	Low	High	--

Hypothetical Combinations

Factors that lower Glycemic Response (GR) to High GI Carbs in diets

Fiber particularly soluble fiber (fruits and vegetables, whole grains, legumes, and nuts)

Fat – delays gastric emptying, slows down digestion (eg Pasta with cheese- AUC down by 58%, Toast with cheese AUC down by 30%)

Suggest using PUFA, Oil seeds, Nuts, oily fish plus carbs

*** Source

Factors that lower Glycemic Response(GR) to High GI Carbs in diets

- Protein – Plant or Animal
- the consumption of foods rich in carbohydrate together with foods rich in protein of animal origin (meat, fish, eggs, dairy products, and derivatives) or vegetable origin (legumes, nuts, and seeds) attenuates GR.
- Vinegar in diets lower the GR- delay gastric emptying and inhibit enzymes
- *** Source

*** Source

Starch processing and lower GR

- Classification of types of resistant starch (RS) and food sources [adapted from Raigond, et al. [\(46\)](#)].

Type of resistant starch	Description	Food sources
RS1	Physically inaccessible, non-digestible matrix	Whole or partly milled grains and seeds
RS2	Ungelatinized resistant starch granules	Raw potato starch, green bananas, high-amylose corn starch
RS3	Retrograded starch (cooled gelatinized starch)	Cooked and cooled potato, bread, pasta, rice, food products with repeated moist heat treatment
RS4	Chemically modified starch	Etherized, esterified or cross-bonded starches (used in processed foods: breads, cakes)

-
- Any processing technique that modifies the food's original structure breaks down the internal components of the food, exposing them to digestion, facilitating absorption, and altering blood glucose. GR +++
 - It is therefore, important to consume foods that preserve their structure and integrity, prioritizing whole foods and not their processed varieties.

*** Source

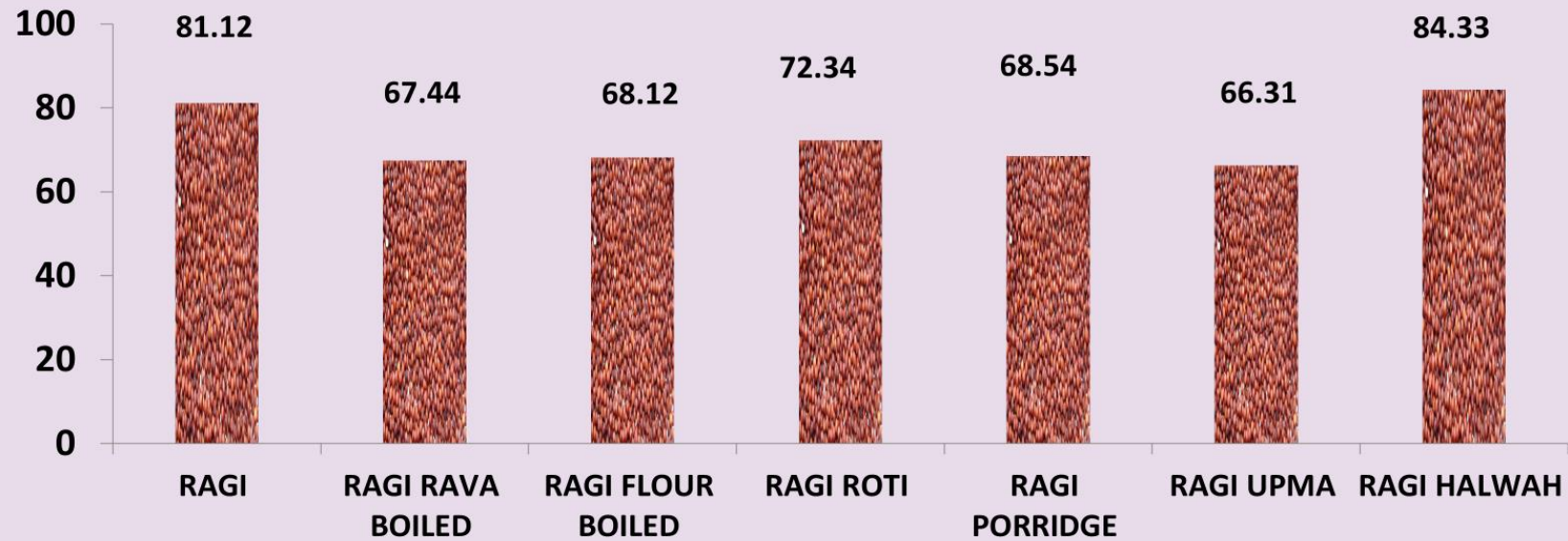
Culinary strategies to manage glycemic response in people with type 2 diabetes: A narrative review

[Serafin Murillo](#),^{1,2,3} [Ariadna Mallo](#),¹ [Alba Adot](#),¹ [Fabiola Juárez](#),¹ [Alba Coll](#),¹ [Isabella Gastaldo](#),² and [Elena Roura](#) ¹. Front Nutr, 2022 Nov



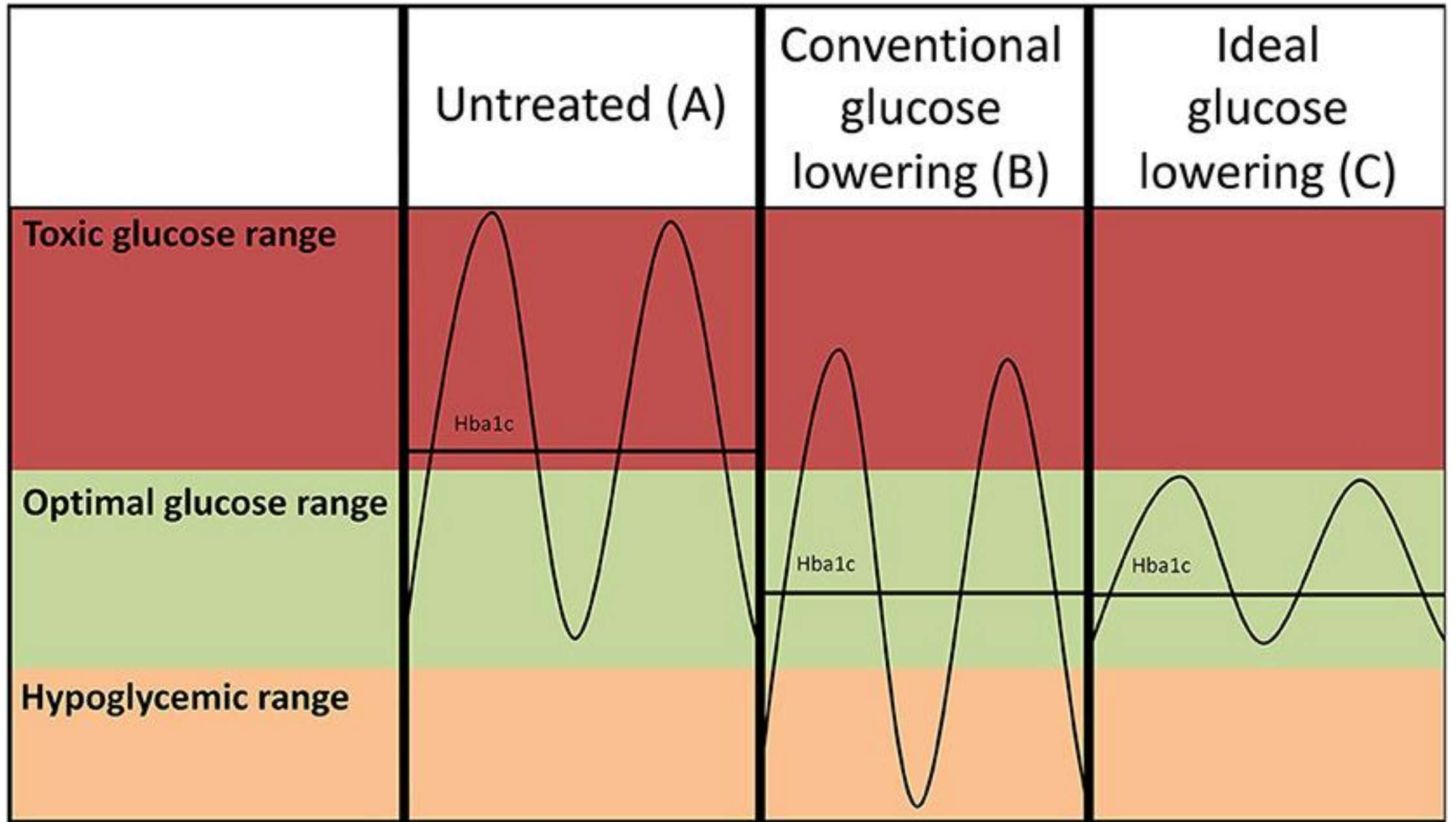
INVITRO GLYCEMIC INDEX-**RAGI** AND ITS PREPARATIONS (Vahini and Bhaskarachary,2017)

INGREDIENT/RECIPE	GLYCEMIC INDEX	GLYCEMIC LOAD
RAGI RAVA BOILED	67.44 ^{ab} ±2.13	15.43 ^b ±4.31
RAGI FLOUR BOILED	68.12 ^b ±2.87	16.54 ^b ±5.12
RAGI ROTI	72.34 ^b ±3.12	21.43 ^a ±3.44
RAGI PORRIDGE	68.54 ^b ±3.65	19.65 ^{ab} ±5.12
RAGI UPMA	66.31 ^c ±8.12	18.44 ^{ab} ±3.11
RAGI HALWAH	84.33 ^a ±3.67	23.21 ^a ±4.55



Managing diabetes through Diet

- No single food GI/GL can be used as an index of safe food for diabetics
- Every food and liquid consumed during the day has to be appropriate not to enhance the glycemic response
- CGM has shown that frequent post prandial spikes in blood glucose can cause harm even if average (HbA1c) is normal



(Hanssen Nordin Mj et al Front. Cardiovasc. Med., 18 September 2020)

Suggested reading:

Prospective Associations between a Food-Based Indian Diet Quality Score and Type 2 Diabetes Risk among South Indian Adults (CURES-154)

Nagarajan Lakshmi Priya^{1,2}, Rajagopal Gayathri^{1,2}, Vasudevan Sudha², Gunasekaran Geetha², Nagamuthu Gayathri², Bhupathiraju Shilpa³, Coimbatore Subramanian Shanthi Rani⁴, Krishnaswamy Kamala², Ranjit Mohan Anjana⁵, Unnikrishnan Ranjit⁵, Selvaraj Pradeep⁶, Viswanathan Mohan⁵

SUMMARY:

Factors affecting starch digestibility & the GI of a food

Internal factors	External factors
Amylose	Cooking
Lipid	Processing
Protein	Retrogradation
Phytic acid	Soaking
Dietary fibre	Germination
Resistant starch	Modification of starch by physical and chemical mean

Thank You for your attention

Exercise the common
denominator

