

## Expliquer un repas et ses mécanismes

Relier les aliments aux apports,  
comprendre les limites.

**Expliquer un mécanisme  
ne prédit pas votre réponse.**

Composition, glycémie, satiété, digestion et contexte : revue ciblée des études humaines et contrat proposé pour des explications pédagogiques.

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Synthèse en français · dossier scientifique en anglais

Propulsé par MedLab

# L'essentiel

Ce que cette recherche permet de retenir

## 01 Partir des faits du repas

Quantités, proportions et contributions des aliments peuvent être décrites lorsque les données sont compatibles et disponibles. Les informations manquantes restent explicites. [Dossier 1-3, 12-13]

## 02 Les mécanismes ne sont pas une courbe personnelle

Structure, préparation, glucides et autres composants peuvent modifier les réponses observées dans les études. Ils ne déterminent pas la glycémie, l'insuline ou la satiété de cette personne. [1-28]

## 03 Respecter la portée des résultats

Effets moyens, incertitude statistique et prédiction individuelle sont distincts. Le nom du repas et l'heure décrivent un contexte, sans créer une limite universelle ou un diagnostic circadien. [Dossier 2, 8-11]

## 04 Des explications à qualifier

Le rapport propose des explications reliées aux faits et un repli local utile. Les fonctions glycémiques et la compréhension de l'interface restent à étudier ; les prédictions personnelles sont différées. [Dossier 12-17, 21]

### Portée et méthode

Revue critique ciblée, non exhaustive. Certaines sources ne sont accessibles que partiellement. La recherche documentaire et les conclusions n'ont pas été actualisées pour cette édition. Les propositions du dossier ne constituent ni une validation clinique de Nutrikom ni une recommandation personnelle.

# Parcourir le rapport

Le dossier scientifique conserve sa pagination de référence : 01 à 21.  
Les renvois internes désignent cette pagination, affichée en pied de page.

**01-03** Composition et mesures physiologiques

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**04-10** Études humaines et limites de transfert

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**11-14** Exemple et contrat d'explication

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**15-17** Cas proposés, méthode et accès

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**18-21** Bibliographie et décision

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## Édition publique

Cette édition ajoute une synthèse française et une navigation au dossier v1.0. La présentation est harmonisée ; les mentions d'outils et d'opérations internes sont retirées. Les données, références, niveaux d'accès aux sources et réserves scientifiques sont conservés. Les propositions décrivent l'état de la recherche à la date du dossier.

## Single-meal physiology and explanation

# Explain mechanisms without predicting the person

**Question ID:** MEAL01

**Date:** 11 October 2026 | **Version:** 1.0

**Population:** generally healthy adults using entered meal foods, portions and estimated composition.

**Disposition: ADOPT FOR DESIGN.** Adopt composition-led, fact-linked educational explanations and a useful local fallback. Investigate a properly sourced glycaemic-load feature and user comprehension. Defer numerical personal glucose/insulin, satiety and digestion predictions until the corresponding model and endpoints are validated.

### Main conclusion

A meal record can describe estimated nutrient amounts, their contributors and compatible energy shares. Human studies support explanations of how carbohydrate source, food structure, preparation, other meal components and context can affect responses. These mechanisms do not identify this user's glucose curve, insulin response, fullness duration or digestion completion time. Group means are not personal predictions. [1–28]

| Keep distinct                      | What Nutrikom can say                                                                                                                            |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Meal composition                   | Amounts, proportions and identified food properties, with uncertainty and missingness.                                                           |
| Recorded daily intake / references | Remain governed by DAY01, REC01 and REF01. A meal is not a daily intake or personal adequacy assessment.                                         |
| Physiological response             | A measured response requires its own measurement. A predicted response requires a defined and independently validated model, beyond this ledger. |
| Meal label / clock time            | "Snack at 15:00" describes the user's label and consumption time. Neither sets a universal snack energy limit nor a circadian diagnosis.         |

### Owner-discussion case

**581 kcal; 92.2 g carbohydrate; about 63% of energy from carbohydrate; Snack at 15:00.** Treat these as supplied discussion inputs, not a newly verified runtime meal. "Massive glycaemic load", "immediate insulin spike" and "unsuitable afternoon snack" are not justified from those inputs alone. The defensible explanation is about carbohydrate contribution and the response information that is missing.

DAY01, REC01 and REF01 v 1.0 were retrieved for continuity. This report does not reopen collection methods/reference tables, diagnose deficiency, prescribe supplements or validate the Nutrikom Index. No code change, runtime measurement or executed verification test is claimed. [D 1–D 3]

## Different outcomes answer different questions

| Outcome                          | How human studies measure it                                                                                                                                               | What a meal log cannot establish                                                                                                                               |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Postprandial glucose             | Serial blood glucose or interstitial CGM; peak, time-to-peak, incremental area under a specified curve (iAUC), duration or total AUC. Sampling window and baseline matter. | A high carbohydrate percentage is not a measured peak. CGM and blood measures are not identical; a two-hour iAUC does not characterize every later response.   |
| Insulin / C-peptide              | Serial blood measurements; peak/AUC and early/late phases. C-peptide reflects secretion differently from peripheral insulin, which is affected by clearance.               | Glucose GI or GL is not an insulin index. Lower glucose can accompany higher insulin; increased glucose can occur with lower insulin secretion. [8, 9, 21, 23] |
| Satiation                        | Processes leading to stopping the current eating occasion; study endpoints include amount consumed during an ad-libitum meal, meal size and termination.                   | A fixed portion being eaten does not measure satiation. "This meal stops hunger" is not established by its macro ratio.                                        |
| Subsequent satiety               | Suppression of hunger between meals; subjective hunger/fullness/desire-to-eat ratings tracked over time.                                                                   | An immediate fullness rating is not a duration forecast. Satiety and satiation must not be merged into one calculated health score.                            |
| Later energy intake              | Measured ad-libitum food intake at a later specified meal, sometimes including preload energy; weighed consumption or controlled intake.                                   | A subjective appetite change does not guarantee lower later energy intake. Hormone changes do not substitute for that endpoint. [12-17]                        |
| Gastric emptying                 | MRI or scintigraphic retention/half-emptying of a particular meal; breath/absorption tests estimate different processes.                                                   | Half-emptying is not completion of digestion. Paracetamol absorption is an indirect measure with limitations, not a direct universal gastric clock.            |
| Digestion / absorption / transit | Mechanical and enzymatic breakdown, nutrient absorption, and intestinal/colonic transport are distinct processes. [27, 28]                                                 | A food disappearing from the stomach is not entirely digested/absorbed or excreted. "Digestion takes three hours" is undefined without an endpoint.            |

### Interpret changes as changes in the measured endpoint

Trials often control portions, overnight fasting, prior diet, posture or sleep. Such controls strengthen causal comparisons within that protocol but restrict transfer to a free-living person and a different dish. Statistical significance does not define a clinically harmful "spike"; there is no single app-ready harmful-spike threshold established here for healthy adults.

Use the exact endpoint, population, comparator and time window when explaining a study. Do not turn an acute glucose difference into a proven long-term disease consequence or a promise of weight loss.

# Glycaemic index and calculated load

## GI measures a relative glucose response, not merely speed

Food GI compares the incremental glucose area following a standardized available-carbohydrate portion with a reference response in the same participants, then summarizes across people. Glucose-reference GI conventionally uses glucose = 100. It is not a percentage of carbohydrate absorbed, a personal glucose peak, or an insulin measurement. A blood-glucose AUC can differ without an equivalent change in time-to-peak. [1, 2, 7]

## Conditional arithmetic

**Component GL = GI × available carbohydrate grams in the entered portion / 100.**

**Calculated meal GL = sum of compatible component GL values.**

**Carbohydrate-weighted calculated GI = sum(GI × available carbohydrate) / sum(available carbohydrate).** The latter is undefined if the denominator is zero. These are calculated descriptors, not measured mixed-meal responses or personal forecasts. [5, 6]

| Gate                    | Minimum requirement                                                                                                                                                                                                                                                               |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Food identification     | A defensible match to a human-tested GI item: food/product, relevant variety, physical form, preparation/cooking and source. A word such as “rice” or “wholegrain” is not a sufficient GI match.                                                                                  |
| Carbohydrate definition | Available carbohydrate for each consumed portion, compatible with the GI study. Do not use total sugars, %energy or an incompatible total-carbohydrate-by-difference field. Fibre/polyol handling must follow the actual database definition.                                     |
| GI provenance           | Original test/table entry, glucose/white-bread reference scale, protocol/population, reported uncertainty, version and matching decision. Convert reference scales only with the documented source-specific method.                                                               |
| Portions and coverage   | Known or explicitly estimated edible quantity and unit conversion. All material carbohydrate sources need matched GI values for a full calculated GL. Missing GI is not zero and must not be invented.                                                                            |
| Uncertainty             | Propagate quantity ranges and GI uncertainty where meaningful; identify proxy/match uncertainty separately. A range of calculated GL is not a personal glucose prediction interval.                                                                                               |
| Validation and label    | Verify arithmetic, carbohydrate basis, item matching and source reproducibility. Use “calculated GI-based load for entered foods”, not “your glucose response”. Before claiming mixed-meal predictive accuracy, validate against measured responses in intended foods and adults. |

Conventional serving-based low/medium/high GL categories do not define “massive”, establish harm, or determine suitability of a snack. No GI values are assigned to the owner case here. A partial calculable subtotal must not appear as the whole meal’s GL. [3, 5–8]

## Human evidence — carbohydrate and prediction

Access: A = original abstract/author record or indexed abstract; I = indexed original excerpts; F = directly accessible full text/targeted sections. Effect uncertainty is reported as published; group uncertainty is not an individual prediction interval.

| Primary study / access          | Population / comparator / methods                                                                                                          | Measured findings                                                                                                                                                     | Limits / disagreement                                                                                                                                    |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| [4] Wolever & Bolognesi 1996; A | 8 lean, young nondiabetic adults; 5 mixed meals, carbohydrate 38–104 g, GI 43–99; serial glucose/insulin.                                  | Responses varied 2.3-fold. Carbohydrate amount + GI equations explained about 90% of variability in mean meal responses ( $P=0.01$ ).                                 | Only five meal means; not 90% individual accuracy. Fat/protein range limited; small selected sample.                                                     |
| [5] Venn et al. 2006; A         | 20 healthy volunteers; glucose dose-response curve; 5 foods at 3 portions, measured available carbohydrate.                                | Calculated vs directly derived GL did not differ significantly in 12/15 combinations; overestimation in 3 combinations.                                               | Same test group and analytically measured carbohydrate. Non-significance is not equivalence; not validation of arbitrary mixed meals.                    |
| [6] Dodd et al. 2011; A         | 30 healthy people; 7 tested foods, 3 meals of potato/rice/spaghetti with chicken, vegetables/sauce; 50 g available carbohydrate.           | Rice meal: calculated GI 51 (95%CI 45–56), measured 38 (33–45). Paper reports meal overestimation 22–50%.                                                             | Weighted constituent GI can rank carbohydrate properties while missing effects of the complete meal. Does not justify a universal correction factor.     |
| [7] Matthan et al. 2016; A      | 63 adults free of chronic disease, 18–85 years/BMI 20–35; repeated 50 g carbohydrate bread/glucose challenges; 5-hour sampling.            | Bread GI $62 \pm 15$ (SD); within-person CV 20%, between-person CV 25%. Insulin index/HbA 1c each explained part of variability.                                      | One food; variability of personal responses and precision of a population food mean are different concepts. Methodological interpretation disputed. [29] |
| [18] Berry et al. 2020; I/A     | PREDICT 1:1002 generally healthy UK adults, including twins; standardized meals and free-living monitoring; separate US validation cohort. | Large between-person differences in glucose, insulin-related/C-peptide and triglyceride responses. Rich-input models, not macro-only arithmetic, assessed prediction. | Measured CGM/metabolic/context data and selected cohorts; commercial conflicts declared. Published model performance cannot be assigned to Nutrikom.     |

### What the disagreement means for design

Some controlled comparisons find strong relations between carbohydrate amount/source and group-average glycaemia; others show miscalibration when ingredient GI values are combined. Methodological commentary defends GI as a population property of food, not a personal response. These findings can coexist. Keep the calculated descriptor separate from any predicted physiological endpoint, and never import a small-study equation as a universal individual model. [4–8, 29]

## Human evidence — mixed meals and structure

| Study / access                | Population / comparator                                                                                                                           | Measured endpoint / result                                                                                                                                                              | Scope and limitations                                                                                                                                                                |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [8] Meng et al. 2017; A       | Four randomized challenge studies; 20–22 adults/study, 50–80 y, BMI 25–30; 50 g bread carbohydrate plus graded cereal, tuna, butter or oat fibre. | More carbohydrate increased glucose iAUC. 50 g added protein reduced glucose iAUC but increased insulin response; tested fat/fibre additions did not significantly change glucose iAUC. | Not all fat or fibre additions automatically reduce glucose. Added nutrients changed energy; two-hour endpoints and specific foods/doses.                                            |
| [9] Karamanlis et al. 2007; A | 9 healthy men; randomized glucose 50 g, gelatin 30 g, or combined 300 mL drinks; 3-hour blood and 13C breath measures.                            | Combined drink lowered glucose and slowed gastric emptying; insulin, incretin and emptying endpoints examined separately.                                                               | Liquid gelatin challenge, not typical meals; combined drink was not isoenergetic to glucose alone. No general per-gram “buffer” coefficient.                                         |
| [10] Vanhatalo et al. 2022; A | Two crossover trials, 30 healthy normal-weight adults/trial; semolina spaghetti/penne vs bread/couscous; 50 g available carbohydrate.             | Two-hour glucose AUC lower for spaghetti: 40% vs couscous, 41% vs bread; penne: 22% and 30% lower ( $P < 0.05$ ). Mastication/in-vitro work explored structure.                         | Similar base ingredients/carbohydrate, different matrices. Exact preparation, no sauces/oils; processing is not uniformly harmful. In-vitro mechanism is not a personal observation. |
| [11] Sonia et al. 2015; A     | 15 healthy adults; randomized single-blind crossover, fresh rice vs cooled 24 h at 4°C then reheated rice.                                        | Glucose-response area: cooled/reheated $125 \pm 50.1$ ; fresh $152 \pm 48.3$ mmol·min/L ( $P=0.047$ ). Resistant starch higher after cooling.                                           | Small acute study and specific rice/protocol; does not authorize a fixed GI reduction for every reheated starch. Dispersion as reported in abstract; not a personal interval.        |
| [12] Juvonen et al. 2009; A   | 20 healthy normal-weight adults; identical-composition oat drinks, low vs high $\beta$ -glucan viscosity; randomized order.                       | Low-viscosity drink produced higher glucose/insulin, faster indirect emptying, but greater subjective satiety ( $P=0.048$ ).                                                            | Total fibre grams do not capture viscosity. This result opposes a universal “slower emptying/lower glucose = greater satiety” chain; no subsequent intake endpoint.                  |

Cooking can change starch gelatinization, retrogradation and food structure. Effects depend on food, variety, water, temperature and physical form. “Cooked”, “cooled”, “processed” and “wholegrain” are not numerical GI values. A measured lower early glucose response does not prove lower total glucose exposure, lower insulin or better long-term health. [3, 8–12]

**Indirect clinical evidence:** Gentilcore 2006 studied six men with type 2 diabetes: 30 mL olive oil or water 30 min before a potato meal, or oil mixed into that meal. Scintigraphic emptying and glucose/insulin/incretin responses were measured. Premeal oil slowed emptying and delayed glucose rise; this small clinical experiment cannot supply a healthy-adult fat dose or meal correction. [26]

## Human evidence — appetite and gastric emptying

| Study / access                                 | Population / comparator                                                                                                                | Measured finding                                                                                                                                             | What cannot be inferred                                                                                                                                                       |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [13] Holt et al. 1995; A                       | 38 foods, isoenergetic 240 kcal portions; groups of 11–13; ratings every 15 min for 120 min and subsequent ad-libitum intake.          | Group food satiety indices differed; average appetite AUC related modestly to later intake ( $r=-0.37$ , $P<0.05$ ).                                         | Not a validated mixed-meal personal satiety score. Correlations with protein/fibre/water do not supply a causal macro-only equation or hours-until-hunger.                    |
| [14] Flood-Obbagy & Rolls 2009; A              | 58 adults; weekly crossover of whole apple, puree, juices±fibre or no preload; matched 125 kcal/weight; lunch 15 min later.            | Whole apple reduced combined preload+lunch energy by 15%, $187\pm36$ kcal (as reported), vs no preload; greater satiety than puree/juice.                    | Short controlled preload context. Adding fibre to juice did not reproduce whole-fruit satiety. Cannot promise that a user will eat 187 kcal less.                             |
| [15] Krishnasamy et al. 2020; A                | 18 healthy adults; randomized open-label 3-way crossover, 178 kcal whole apple/puree/juice; MRI over 270 min and appetite ratings.     | Half-emptying mean±SEM $65\pm3.3$ , $41\pm2.8$ , $38\pm2.9$ min, respectively ( $P<0.0001$ ). Whole apple increased fullness/satiety vs juice.               | No glucose/insulin or later food intake outcome reported in accessed abstract. Half-emptying is not total digestion duration; means not personal times.                       |
| [16] Flint et al. 2000; I; NCI instrument page | Single test-meal VAS reproducibility/validity study; subjective appetite measurements compared with later intake.                      | Supports carefully specified appetite-rating questions as measured self-report; does not convert nutrient composition into a rating.                         | Full original report not retrieved; no new coefficient or population-level correlation quoted here. Phone slider implementation needs its own usability/measurement checks.   |
| [17] Liu et al. 2025; I                        | Randomized healthy-adult trial; low/medium/high GI intervention meals at constant macros; metabolic, hunger and later intake measures. | Glucose/insulin followed GI ordering; subjective hunger did not. Group intake differences did not become simple individual glucose/insulin→intake relations. | Original indexed abstract; sample size and quantitative effects not verified from accessed material. Included as recent endpoint disagreement, not a calibrated effect model. |

Protein, fibre, volume, water content, texture, eating rate, palatability and prior hunger can influence appetite in particular settings. No universal ordering of macros supplies a personal satiation/satiety rating. The evidence supports conditional explanations and separately collected user ratings, not a “satiety 8/10” generated from meal macros. [12–17]

## Human evidence — timing as an independent factor

| Study / access               | Controlled comparison / population                                                                                                         | Measured effect                                                                                                                                                 | Limits for app timing                                                                                                                                                                              |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [20] Gu et al. 2020; F       | 20 healthy adults, mean age 26; randomized dinner 18:00 vs 22:00; same daily energy/macros, sleep 23:00–07:00. Dinner/snack times swapped. | Late-dinner glucose peak 18% higher: $150.3 \pm 5.6$ vs $127.0 \pm 4.5$ mg/dL (SEM); 4-hour glucose AUC higher ( $P < 0.001$ ). Earlier sleepers more affected. | Acute laboratory schedule, young nonobese adults; no chronic weight outcome. 22:00 near bedtime cannot classify a 15:00 snack.                                                                     |
| [21] Morris et al. 2015; F   | 14 healthy adults, 20–49 y; two 8-day crossover protocols, circadian alignment vs 12-hour misalignment; identical meals at 8:00/20:00.     | Biological-evening glucose 17% higher with 27% lower early insulin; misalignment glucose 6% higher with 14% higher late insulin.                                | Small intensive laboratory protocol; source-defined phase, not an app's clock label. Cannot infer insulin direction from glucose alone.                                                            |
| [22] Bandín et al. 2015; A   | 32 healthy young women in 2 protocols; metabolic subgroup $n=10$ ; randomized standardized lunch 13:00 vs 16:30 over intervention weeks.   | Late lunch increased baseline-adjusted glucose area 46% ( $P=0.002$ ); other protocol assessed cortisol/wrist temperature.                                      | Glucose endpoint $n=10$ , not 32. Timing can also change interval since breakfast; not proof that every afternoon snack is unsuitable.                                                             |
| [23] Garaulet et al. 2022; A | 845 Spanish adults; crossover 75 g OGTT 4 h vs 1 h before habitual bedtime after 8 h fast; melatonin/genotype measured.                    | Late condition: glucose AUC 8.3% higher; insulin AUC 6.7% lower; melatonin 3.5-fold higher; genetic interaction.                                                | OGTT, not a mixed dinner. Generally nondiabetic scope but not an unrestricted healthy-meal model. Bedtime relation is more informative than clock hour; no genotype profile required for this app. |

### Causal interpretation

Randomized meal-timing crossover studies support an acute timing effect under their protocols. They do not identify an optimal clock time for every user. Circadian-phase experiments distinguish internal time from eating/sleep behaviours more closely than observational studies, but are still mechanistic extrapolation for a 15:00 meal without phase measurements. [20–23]

Avoid “afternoon carbohydrates are poorly metabolized”, “this snack will be stored as fat” or “eat before 15:00”. Extra context can improve a conditional explanation, but does not make the measured group effect a personal correction factor.

## Timing context, activity and observational evidence

| Context / primary evidence             | What it changes                                                                                                                                                                                                                                    | What remains unknown                                                                                                                                                  |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Previous intake [19]                   | Meng 2017:20 healthy adults; randomized isocaloric high-carbohydrate/fat/protein breakfasts, bread/glucose challenge 4 h later. High-protein breakfast reduced later bread glucose iAUC ( $P < 0.0001$ ).                                          | Time since previous intake and its composition can matter. A blank ledger does not prove fasting. No universal “second-meal” multiplier can be applied.               |
| Activity [25]                          | Peddie 2013:70 healthy normal-weight adults; 9 h sitting, 30 min walk then sitting, or 1 min 40 s walks every 30 min. Glucose iAUC lower with breaks vs sitting by 18.9 (95%CI 10.0–28.0), in paper-reported mmol/L/9 h units; insulin also lower. | Recent/next activity intensity and duration can affect responses. No fixed exercise credit cancels carbohydrate grams or guarantees spike prevention.                 |
| Internal phase [24]                    | McHill 2017:110 adults 18–22 y, 30-day cross-sectional study; food timing relative to melatonin onset associated with body fat, clock-hour timing was not.                                                                                         | Observational, selected young cohort; confounding/reverse causation. Does not prove causal weight gain from a single late meal.                                       |
| Sleep/wake and shift work [20, 21, 23] | A clock time can correspond to after waking, during a usual day, before sleep or after an overnight shift. Bedtime relation changes applicability of late-dinner evidence.                                                                         | Reported sleep/wake is context, not a measured circadian phase. Habitual schedule and recent disruption differ; do not infer melatonin concentration from clock time. |
| Purpose / planned next meal            | Hunger, preference, whether this replaces lunch, next meal plans and activity goals make a food idea more relevant.                                                                                                                                | These are user context, not new evidence of glycaemic risk or personal energy requirement. “Snack” is not a physiological category.                                   |

### What “Snack at 15:00” alone permits

Say that the entry was labelled Snack and recorded as consumed at 15:00, if those are the actual field meanings. Do not infer a previous lunch, a three-hour fast, standard bedtime, sedentary afternoon or weight-loss goal. The label could mean a small bite, a substantial eating occasion or a meal replacement.

### Smallest useful optional context — UX proposal

When relevant, ask: “When did you last eat or drink something with energy?”, “Does this replace a meal?”, or “Is this close to your usual bedtime?” Recent activity and sleep schedule may be optional context. Require a confirmed preceding interval before claiming no caloric intake. Do not require a universal chronotype, genetic test or continuous glucose monitor for the educational meal view.

Additional context changes the relevance and conditional wording of evidence. It does not, by itself, validate a numerical response prediction. Cultural meal schedules and shift work make clock-based universal judgements particularly unreliable.

## Claim matrix — supported general explanation

S = supported general explanation; C = conditional estimate; I = insufficient evidence for this output; P = prohibited personal inference within this contract. Classification concerns the proposed app claim, not the biological importance of the topic.

| Claim / class                          | Required inputs                                                                                                                                        | Allowed explanation / limitation                                                                                                                                       |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Composition contribution — S           | Entered edible amounts, food matches, nutrient values/bases and uncertainty. Server calculation and nutrient-specific coverage.                        | “Carbohydrate supplies most of this meal’s estimated energy.” Supported only if a compatible share actually exceeds half; not a GL or suitability classification.      |
| Amount and quality of carbohydrate — S | For a general mechanism: curated evidence. For meal linkage: identified foods and compatible carbohydrate amounts.                                     | “Both the amount and source of carbohydrate can influence the glucose response.” Do not identify an unknown food’s GI from its name/category alone. [3–8]              |
| Structure/cooking effects — S          | Known intact/liquid/pureed or relevant preparation facts; curated matched evidence. Otherwise explicitly general conditional wording.                  | “Food structure and cooking can change starch accessibility.” No fixed decrease after cooling or claim that all processed foods have high GI. [10–12, 15]              |
| Mixed-meal effects — S                 | Known protein/fat/fibre amounts or identified components; evidence-specific qualification. Fibre type/viscosity needed for a specific viscosity claim. | “Other meal components can change the response; effects depend on food, dose and person.” Not “fat/protein blocks the carbs” or a guaranteed flatter curve. [8, 9, 12] |
| Appetite mechanisms — S                | Composition/structure facts and general human evidence; specify subjective satiety versus later intake.                                                | “Texture, volume and meal composition can influence fullness.” Avoid promising fullness until dinner or less later eating. [12–17]                                     |
| Timing relevance — S                   | Clock time for reporting; prior intake, sleep/wake or activity for contextual link; provenance and time zone.                                          | “Clock time alone does not tell us how this fits your day.” Known near-bedtime context can introduce late-eating evidence with its population/protocol limits. [19–25] |
| Food alternative — S                   | Known original food/context; optional preferences and allergy/exclusion constraints. Source supports the educational food-property explanation.        | “Whole fruit is an option to explore instead of juice.” Do not promise a physiological result or invent the new meal’s nutrient contributions. [14, 15]                |

General explanations are educational tendencies, not diagnoses or guaranteed directions. Use “can”, “may”, “in the study” and “depends on” where they carry real conditions. Do not weaken an unsupported personal prediction simply by adding “may”.

## Claim matrix — numerical and personal outputs

| Output / class                                       | Minimum data + validation                                                                                                                                                                                                                          | Disposition / boundary                                                                                                                                                                    |
|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Carbohydrate energy share — C                        | Compatible carbohydrate-energy basis; total energy for same entered portion/scope; handling of polyols/fibre/alcohol; server rounding/coverage.                                                                                                    | ADOPT descriptive calculation only. Not daily adequacy, absorbed glucose or %personal needs. Incompatible basis makes share unavailable.                                                  |
| GI-based meal GL — C                                 | Human-tested, preparation-compatible GI values for material carb sources; glucose scale; available-carbohydrate amounts; coverage and error propagation. Validate matching/calculation.                                                            | INVESTIGATE. Publish as a conditional computed descriptor with assumptions. Claiming response prediction requires additional mixed-meal validation.                                       |
| Numerical glucose prediction — I                     | Defined endpoint/time window, baseline glucose/device basis, validated food/portion/preparation and context inputs; a prespecified model. Independent representative external validation of individual error/calibration and prediction intervals. | DEFER. A food GI, a carb percentage or a small-study meal-mean regression is insufficient. Personal calibration may be needed; no universal minimum sample/person-day count is specified. |
| Numerical insulin prediction — I                     | Endpoint-specific measured insulin data, baseline/assay/sampling information and compatible model inputs. Independent validation against insulin outcome, not just glucose/CGM.                                                                    | DEFER. GI/GL and CGM do not directly measure insulin. Protein-related insulin stimulation and circadian effects defeat simple glucose→insulin substitution.                               |
| Predicted satiety score / hours until hunger — I     | Defined construct and horizon; model with tested foods/portions, baseline appetite, context and subsequent ratings. Validate individual performance and distinguish ratings from actual later intake.                                              | DEFER macro-derived rating. A satiety-index average cannot become a personal mixed-meal score. Perceived satiety cannot stand in for lower calorie intake.                                |
| User-reported hunger/fullness — C                    | Explicit question/anchors, response scale, measured time relative to meal and baseline if claiming change. Check digital/language measurement properties.                                                                                          | ADOPT optional self-report as such; never label it an app-predicted satiety score or objective physiological measurement. [16]                                                            |
| Digestion-time estimate — I                          | First specify endpoint: gastric t50, retention, absorption or transit. Define meal physical properties/dose and relevant context; validate model against endpoint-specific measurement.                                                            | DEFER generic digestion clock. Diagnostic reference times for a standardized scintigraphy meal cannot time a user's mixed dish. [15, 27, 28]                                              |
| Personal spike / crash / harm / unsuitable snack — P | Current inputs provide no validated physiological or clinical decision rule.                                                                                                                                                                       | PROHIBIT "immediate insulin spike", "massive GL" from carbs alone, "blood-sugar crash expected", fixed suitability verdicts and absence-of-risk claims.                                   |

## Stress test of the owner-discussion case

**Discussion facts only:** 581 kcal; 92.2 g carbohydrate; about 63% energy from carbohydrate; user label Snack; 15:00. Foods, preparation, fibre/protein/fat breakdown, GI values and personal context are not supplied here. No runtime meal was fetched or independently verified.

### What the arithmetic says

If the 92.2 g field is compatible available carbohydrate using 4 kcal/g, carbohydrate energy = 368.8 kcal and its share =  $368.8/581 \times 100 = 63.48\%$ , **approximately 63.5%**. “About 63%” is a coarse discussion approximation. If total carbohydrate includes fibre/polyols that require different factors, the supplied share must be verified or withheld. The remaining 212.2 kcal must not be assigned to invented protein/fat amounts.

| Proposed claim                                       | Verdict / reason                                                                                                                                                                                            |
|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| “Massive glycaemic load”                             | Unsupported. Numerical GL needs food-specific compatible GI and available-carbohydrate portions. 92.2 g carbohydrate and 63% energy are not GL. “Massive” supplies no valid scale or harmfulness threshold. |
| “Immediate insulin spike”                            | Unsupported personal inference. No insulin was measured, no validated prediction exists, and an acute insulin response can be normal physiology. GI/GL cannot determine its magnitude or timing.            |
| “Unsuitable afternoon snack”                         | Unsupported judgement. 581 kcal does not define a universal snack maximum. Label/time alone omit whether this replaces lunch, prior intake, hunger, next meal, activity and sleep context.                  |
| “Carbohydrate provides most of the estimated energy” | Supported conditional composition description if the carbohydrate-energy basis and supplied estimate are compatible. It says nothing definite about personal response.                                      |
| “At 15:00, glucose tolerance is poor”                | Unsupported transfer. Late-lunch/dinner trials compare specific schedules in selected adults; they do not establish a 15:00 threshold or classify this owner case.                                          |

### Short English local explanation — proposal

#### Carbohydrate share

“Carbohydrate supplies most of this meal’s estimated energy. Food structure, preparation and personal context affect the glucose response, which these entries do not measure.”

The server may display supplied figures with a “discussion example” tag in this report or a confirmed estimate in the app. Do not attach a food idea to this case until actual food identities are known. A neutral optional question can ask whether it replaces a meal; it must not imply that the current choice was wrong.

## Similar macros can conceal different meals

| Comparison                                             | Evidence-supported explanation                                                                                                                                           | What stays conditional                                                                                                                                                    |
|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Semolina pasta vs bread/couscous                       | Human trials with 50 g available carbohydrate from the same flour show different glucose AUCs; pasta's matrix persisted differently during mastication/digestion. [10]   | Matching carbohydrate and roughly similar ingredients is not proof all nutrients/portions are identical. Do not import a 40% reduction into an untested dish with sauces. |
| Whole apple vs puree/juice                             | Isocaloric human comparisons show differences in gastric half-emptying and fullness; a separate preload trial measured lower subsequent combined energy intake. [14, 15] | Two studies have different outcomes/protocols. No glucose peak was measured in the MRI study; whole fruit cannot be promised to prevent a spike.                          |
| Same oat macros/fibre, different viscosity             | Chemically matched drinks produced different glucose, insulin, emptying and subjective satiety responses. [12]                                                           | Total fibre grams alone do not reveal $\beta$ -glucan viscosity. Higher viscosity did not universally produce higher subjective satiety in that experiment.               |
| Fresh rice vs cooled/reheated rice                     | A small human crossover found different resistant starch and glucose-response area under a specific preparation. [11]                                                    | Known cooking history supports a general explanation, not a numerical adjustment without a measured matching source. Do not silently rewrite carbohydrate content.        |
| Same meal near different bedtime/activity/prior intake | Crossover evidence shows response depends on these contexts under controlled conditions. [19-23, 25]                                                                     | Clock labels/macros alone cannot assign the effect. Increased context improves applicability, not certainty of a personal prediction.                                     |

### Optional alternatives without promises — UX proposal

Offer one user-controlled idea relevant to an entered food or preference. Explain a property, not a guaranteed endpoint: “If you want a different texture, whole fruit is an option instead of juice; studies found greater fullness in some controlled comparisons.” Other options may explore legumes or less disrupted grain forms when appropriate, without declaring that every such food has a known GI.

Never prescribe “replaceX g withY g”, say “this prevents a spike”, guarantee fullness, or fabricate new protein/fibre contributions. A gram-for-gram nutrient comparison requires actual food matches, selected portions and a server recalculation, with its own uncertainty. An optional idea does not change the recorded meal until the user edits it.

Respect allergies, food availability, dietary/cultural preferences and clinical exclusions. When identity/preference information is insufficient, omit the idea. Educational alternatives need not maximize a score or imply an optimum meal.

## Fact-linked optional AI contract

Proposed contract, not an implemented or validated Nutrikom feature. Keep deterministic meal facts and a local explanation available before optional AI wording. The model can phrase authorized explanations; it cannot create amounts, reference values, nutrient contributions, sources or physiological predictions.

| Contract element        | Minimum rule                                                                                                                                                                                                                                               |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| fact registry           | Stable IDs for meal scope/revision, food matches, edible amounts, energy/macros/fibre, definitions, preparation, missingness, label, consumption time/time zone and context. Each fact includes provenance and estimate/known/unknown state.               |
| derived facts           | Server computes compatible energy shares, totals/contributions and any authorized calculated descriptor. Preserve inputs/formulas/rounding and coverage; publish no derived fact if required inputs are incompatible.                                      |
| evidence registry       | Curated claim IDs with sources, population, comparator, endpoint, direction/limitations and permitted conditions. Original attribution links and versions are selected by server, not invented by model.                                                   |
| optional AI response    | brief title; 1–2 explanatory sentences; optional food idea or null; fact_ids; evidence_claim_ids; conditionality. No unsupported personal forecast or medical classification.                                                                              |
| figures and attribution | Display numeric facts and bibliography from server-controlled components. AI prose contains no freehand new numbers, percentages, GI values, dose/gram swaps, times-to-digest or citation URLs. If a fact token is used, server resolves only allowed IDs. |
| explicit conditionality | State “general mechanism”, “depends on food/preparation/context”, or the actual unmet condition. A claim linked to unknown preparation must remain general, not say “your cooled rice”.                                                                    |
| food idea gate          | Requires known food/context and any supplied exclusions. One optional, non-quantified idea with a property explanation; no promise or automatic substitution. null is acceptable.                                                                          |
| output validation       | Check allowed IDs/revision, fact support, evidence conditions, numerical tokens and prohibited claim types. Reject new figures/attribution or misleading implication. Structural JSON validity alone does not establish scientific validity.               |
| fallback and edits      | Failure, timeout, refusal or absent AI returns the same useful local amount view and authorized local explanation. Changed ledger/context invalidates stale facts and regenerates explanations; do not reuse old AI text against a new meal.               |

### Local engine remains useful

Display known amounts, contributors and coverage. Select a short curated explanation only when its conditions are met; otherwise explain what the record describes and what it does not measure. This local view does not require an AI call or a clinical questionnaire. AI fluency must never conceal partial composition or transform unknown into zero.

# AI example and short English wording

## Example payload — owner discussion facts; no invented foods

**Server facts:** F\_CASE\_SCOPE=owner\_discussion; F\_ENERGY=581 kcal (supplied); F\_CARB=92.2 g (supplied); F\_CARB\_SHARE=conditional 63.48%; F\_LABEL=Snack; F\_TIME=15:00; F\_GI\_COVERAGE=unavailable; F\_FOODS=not\_supplied. The share is only publishable after the server confirms its carbohydrate basis.

| Response field        | Illustrative value                                                                                                                                                            |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| title                 | Carbohydrate share                                                                                                                                                            |
| explanatory sentences | Carbohydrate supplies most of this meal's estimated energy. Food structure, preparation and personal context affect the glucose response, which these entries do not measure. |
| food_idea             | null — food identities not supplied                                                                                                                                           |
| fact_ids              | F_CASE_SCOPE; F_ENERGY; F_CARB; F_CARB_SHARE; F_GI_COVERAGE                                                                                                                   |
| evidence_claim_ids    | E_CARB_SOURCE_AMOUNT (sources 4–8); E_STRUCTURE_CONTEXT (10–12, 19–23)                                                                                                        |
| conditionality        | Composition estimate only; no measured/predicted personal response. Share requires compatible carbohydrate-energy basis.                                                      |
| server attribution    | Source labels/links and visible supplied/estimated-status badge selected from registry; no model-generated source.                                                            |

## Alternative short local messages — select at most one relevant focus

| Trigger                     | Title and 1–2 sentences                                                                                                                                                                   |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Unknown GI                  | Glucose response — “These entries describe carbohydrate amounts, not your glucose response. A calculated glycaemic load also needs matched GI values and available-carbohydrate amounts.” |
| Known whole fruit / juice   | Food structure — “Whole fruit and juice differ in physical structure. Controlled studies found different fullness and gastric-emptying responses; this does not predict your response.”   |
| Partial fibre data          | Partial composition — “Fibre data are missing for some entries. The current estimate cannot establish whether this meal is low in fibre or how filling it will feel.”                     |
| Clock time only             | Timing context — “This entry is labelled Snack at 15:00. Clock time alone does not tell us how it fits your meals, activity or sleep.”                                                    |
| Known close-to-bedtime meal | Meal timing — “In controlled studies, eating closer to bedtime changed glucose handling. Your sleep schedule gives context, but these entries do not predict your glucose or insulin.”    |
| User fullness rating        | Your reported fullness — “This is how full you reported feeling after the meal. It is a subjective rating, not a prediction of when you will next feel hungry.”                           |

These precise titles, limits, optional questions and display choices are UX hypotheses. Validate understanding and tone, not merely whether the text sounds plausible. “May cause a spike” remains an unsupported personal inference when the underlying prediction is absent.

## Verification cases — composition and GI

Proposed acceptance cases only; none are executed runtime tests. Use explicitly synthetic values for arithmetic fixtures, never as GI assignments to real foods.

| Case                                                | Expected behaviour                                                                                                                                           |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V01. Owner case as supplied                         | Show discussion scope; conditional carbohydrate share about 63.5%. No massive-GL, insulin-spike or snack-suitability claim; food idea omitted.               |
| V02. Carbohydrate-by-difference includes fibre      | Do not apply 4 kcal/g to all carbohydrate or use it for GL until definition is reconciled. No silent double subtraction of fibre.                            |
| V03. Synthetic compatible GI 40, carbohydrate 30 g  | Arithmetic GL 12; descriptor labelled calculated for synthetic inputs. No conversion to mmol/L, insulin peak or a safety verdict.                            |
| V04. Synthetic 2 components: GI 40×30 g, GI 70×20 g | Calculated GL 26; weighted calculated GI 52. Validate same glucose scale and denominator 50 g. Do not present measured meal GI or personal glucose response. |
| V05. One carbohydrate food lacks GI                 | Full meal GL unavailable; if partial subtotal shown, name covered items and missing component. Missing GI is not 0; no imputation by model.                  |
| V06. All reported available carbohydrate truly 0    | No carbohydrate-weighted GI division. Recorded carb 0 does not establish insulin 0 or prove absence of a physiological response.                             |
| V07. White-bread-reference GI imported              | Require source-documented scale normalization or withhold. Do not assume same numeric value as glucose-reference GI.                                         |
| V08. “Rice” without variety/preparation             | Food category alone does not match a GI entry; allow general preparation explanation, not a fabricated GI or cooling correction.                             |
| V09. Quantity range or household measure            | Preserve assumptions/range. Calculated GL may be uncertain even with GI data; its range is not a personal glucose confidence interval.                       |
| V10. Unknown fibre vs confirmed zero                | Unknown stays missing. “Low fibre” and predicted low satiety blocked unless supported by actual compatible coverage; truezero remains a separate state.      |
| V11. Same macros; pasta vs bread                    | Explain matrix differences using evidence; do not guarantee a 40% personal reduction or infer exact preparation from generic names.                          |
| V12. Cooled/reheated entry                          | No automatic percentage reduction, GI substitution or nutrient rewrite. Require matching source/preparation for numerical comparison.                        |
| V13. Protein addition                               | May explain that glucose and insulin can respond differently. Do not promise prevention of spikes or infer insulin lowering from glucose lowering.           |
| V14. Fibre grams identical, viscosity unknown       | Do not infer identical glucose/satiety or a viscosity effect. Retain general conditional explanation.                                                        |

## Verification cases — response, timing and AI

| Case                                          | Expected behaviour                                                                                                                                                                     |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V15. Meal labelled Snack, 581 kcal            | Do not rename it, assign a universal snack maximum or declare unsuitable. Optional meal-replacement context may refine explanation.                                                    |
| V16. 15:00 with no previous-intake data       | Do not infer lunch, fasting interval, hunger or sedentary behaviour. Clock/label remain descriptive.                                                                                   |
| V17. No entry since noon, coverage unreviewed | A missing ledger entry is not confirmed non-consumption; no “three hours fasted” fact.                                                                                                 |
| V18. 15:00 after a night shift                | Reported sleep/wake context can change applicability. Do not force standard daytime circadian phase or import late-dinner effect sizes.                                                |
| V19. Same food 1 h vs 4 h before bedtime      | Explain protocol-specific timing evidence; no 8.3% personal correction or automatic insulin direction.                                                                                 |
| V20. Recent walk or planned exercise          | Activity contextual explanation allowed; no fixed subtraction from carbohydrate or guaranteed glucose-spike prevention.                                                                |
| V21. User reports fullness 8/10 at 30 min     | Display user report/time as self-report. Do not label model-generated satiety 8/10 or forecast hours of fullness.                                                                      |
| V22. Gastric half-emptying study mean 65 min  | Use only as attributed group study result, not personal “digested in 65 minutes”. Half-emptying differs from absorption/transit.                                                       |
| V23. Two-hour CGM curve available elsewhere   | That data would need source/device/baseline/window checks. Do not infer measured insulin, toxicity, satiety or later calories from CGM alone; outside current ledger prediction scope. |
| V24. Diabetes or GI disease disclosed         | Healthy-adult explanation scope flagged; clinical evidence labelled indirect. No medication/insulin adjustment, gastric-disorder diagnosis or supplement advice.                       |
| V25. AI adds “immediate insulin spike”        | Reject despite valid JSON or hedging. Show authorized local explanation.                                                                                                               |
| V26. AI invents GI, fibre or citation URL     | Reject freehand figures/attribution; retain server facts. Never fill unknown GI with a plausible value.                                                                                |
| V27. Idea: “swap 50 g to prevent a spike”     | Reject quantitative prescription and promise. Optional food idea must be non-quantified and supported by known context.                                                                |
| V28. Allergic/excluded food suggestion        | Idea suppressed; no automatic substitution. Respect supplied dietary constraints without inventing clinical benefit.                                                                   |
| V29. API timeout / AI unavailable             | Meal amounts, coverage and local explanation remain useful. Do not display an empty section or a fabricated response.                                                                  |
| V30. Portion/time/context later edited        | Recompute server facts, invalidate obsolete explanation/links and version; do not reuse a stale case or silently claim successful reanalysis.                                          |

# Search method, access and inference limits

**Search date:** 11 October 2026. Targeted English-language human-evidence review, not a registered systematic review or exhaustive meta-analysis. Generally healthy adults prioritized; foundational methods and recent human trials retained without a fixed year cutoff. Original institutional sources define measurements; commercial calculators and general news are not evidence authorities.

| Route                     | Reproducible search description                                                                                                                                                                                                                                                                                                    |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scholarly discovery       | Queries: “healthy adults food structure whole apple satiety gastric emptying appetite randomized crossover”; “healthy adults mixed meal carbohydrate amount glycemic index protein fat glucose insulin randomized”; “healthy adults meal timing circadian glucose tolerance late dinner randomized crossover”.                     |
| Targeted scholarly search | Exact Dodd mixed-meal GI title used to locate related GL-validation, GI-variability and 2021 table records. Relevant records were consulted before citation; original sources were sought for verification.                                                                                                                        |
| Web verification          | Exact author/title queries for Matthan 2016, Dodd 2011, Wolever 1996, Meng 2017, Karamanlis 2007, Vanhatalo 2022, Sonia 2015, Juvonen 2009, apple studies, Holt 1995, Flint 2000, Liu 2025, Berry 2020 and timing/activity studies. Follow-up DOI/PMID and outcome searches verified populations, endpoints and numerical details. |
| Institutional sources     | FAO 1998 GI chapter and 2003 carbohydrate-analysis chapter; ISO 26642:2010 overview; NCI appetite-rating instrument page; ANMS/SNM gastric-emptying consensus; NIDDK digestion explanation. Read prior DAY01/REC01/REF01 boundaries without revisiting their reviews.                                                              |
| Inclusion and extraction  | Primary randomized/crossover feeding experiments, relevant observational circadian study, physiological prediction cohort and methods studies. Extract sample, comparator, measured endpoint, effect/uncertainty, access and transfer limits. Diabetes experiment retained explicitly as indirect.                                 |
| Synthesis                 | No pooled effect or quantitative grading. Separate experimental causal comparisons, observational associations and in-vitro/mechanistic extrapolation. Group effects and statistical uncertainty are not individual prediction errors.                                                                                             |

## Access limitations

Gu 2020 full publisher text, Morris 2015 targeted PMC sections and Peddie 2013 original abstract were accessible. Several abstracts were available via author institutions or indexed bibliographic records. Some primary pages provided only metadata or access restrictions; indexed original excerpts were used where specified. No paywall was bypassed. ISO overview was read; the complete standard was not purchased/read.

Liu 2025 and Flint 2000 were not read in full; unverified sample/effect details are not invented. GI tables include method-quality tiers and do not eliminate missing preparation matches. The UK/US/European/Asian/UAE samples do not validate every food culture, clinical group or consumer app. No individual prediction or UX design in this report has been validated for Nutrikom.

## Bibliography — GI, carbohydrate and mechanisms

A = original abstract/author record or indexed abstract; I = indexed original excerpts; F = directly accessed full source/targeted sections. Retrieved 11 October 2026. References identify original human studies unless labelled institutional guidance or compilation. Study tables provide population, methods, results and limitations.

**[1] FAO/WHO(1998). Carbohydrates in Human Nutrition, Chapter 4; FAO(2003), methods of food analysis.**  
<https://www.fao.org/4/w8079e/w8079e0a.htm>

F. Original GI definition and methodological cautions; historical guideline, not personal mixed-meal validation.

FAO 2003 carbohydrate analysis/basis

**[2] ISO 26642:2010. Determination of GI and recommendation for food classification.**

<https://www.iso.org/standard/43633.html>

Public institutional overview accessed; full normative text not accessed. Use a recognized human test protocol, not an app-generated value.

**[3] Atkinson et al.(2021). International tables of GI and GL values 2021.**

<https://doi.org/10.1093/ajcn/nqab233>

Fetch abstract + original indexed records. Compilation:~2100 more robust and~1900 less robust food items; regional/manufacturing variation. Not a personal-response model.

**[4] Wolever & Bolognesi (1996). Prediction of glucose and insulin responses after mixed meals.**

<https://doi.org/10.1093/jn/126.11.2807>

A. Eight nondiabetic adults; mean-meal prediction over a limited range, not individual calibration.

**[5] Venn et al.(2006). GL estimated from GI versus a measured standard curve in healthy volunteers.**

<https://doi.org/10.1093/jn/136.5.1377>

A. 20 adults; analytically measured available carbohydrate and the same test participants; limited foods/portions.

**[6] Dodd et al.(2011). Calculated meal GI compared with directly measured meal GI.**

<https://doi.org/10.3945/ajcn.111.012138>

A. 30 healthy adults; mixed-meal overestimation and source/matrix limitations; PMID 21831990.

**[7] Matthan et al.(2016). Reliability and methodological/biological variability of GI.**

<https://doi.org/10.3945/ajcn.116.137208>

A. 63 adults; within-/between-person variation; PMID 27604773. Group-mean GI and individual glucose response differ.

**[8] Meng et al.(2017). Macronutrients/fibre and meal GI/GL determinations.**

<https://doi.org/10.3945/ajcn.116.144162>

A. Specific graded additions and 2-hour glucose/insulin; PMID 28202475. No universal fat/fibre effect.

**[9] Karamanlis et al.(2007). Protein, glycaemic/incretin responses and gastric emptying.**

<https://doi.org/10.1093/ajcn/86.5.1364>

A author institutional abstract. Nine healthy men; gelatin/glucose liquid challenge, not isoenergetic whole-food meal comparison; PMID 17991647.

## Bibliography — structure, satiety and variability

**[10] Vanhatalo et al.(2022; online 2021). Pasta structure, mastication and postprandial metabolism.**

<https://doi.org/10.1093/jn/nxab361>

A author institutional record. Two 30-person healthy crossover trials; human glucose results plus mastication/in-vitro mechanism; PMID 34669959.

**[11] Sonia, Witjaksono & Ridwan (2015). Cooling cooked white rice, resistant starch and glycaemic response.**

<https://doi.org/10.6133/apjcn.2015.24.4.13>

A Universitas Indonesia abstract. 15 healthy adults; small preparation-specific crossover; PMID 26693746.

**[12] Juvonen et al.(2009). Viscosity of oat bran beverages and gastrointestinal responses.**

<https://doi.org/10.3945/jn.108.099945>

A VTT original abstract. 20 healthy adults, matched chemical composition; subjective satiety and metabolic directions differed; PMID 19176745.

**[13] Holt et al.(1995). A satiety index of common foods.**

<https://pubmed.ncbi.nlm.nih.gov/7498104/>

A Macquarie original abstract. Small groups and isolated 240 kcal foods; not personal/mixed-meal score validation.

**[14] Flood-Obbagy & Rolls (2009). Fruit form, energy intake and satiety at a meal.**

<https://doi.org/10.1016/j.appet.2008.12.001>

A Penn State original abstract. 58 adults; matched preload and measured lunch intake; short-term controlled context.

**[15] Krishnasamy et al.(2020). Apples, puree/juice, gastric emptying and satiety.**

<https://doi.org/10.1093/jn/nxaa191>

A + fetched record. 18 healthy adults; MRI half-emptying and ratings, not personal total-digestion clock; PMID 32805050.

**[16] Flint et al.(2000). Reproducibility/power/validity of appetite VAS in single test-meal studies.**

<https://doi.org/10.1038/sj.ijo.0801083>

I original record; full report not retrieved; PMID 10702749. Measured self-report and a predicted score are different outputs.

NCI original instrument resource

**[17] Liu et al.(2025). Testing the carbohydrate-insulin model with varying GI meals.**

<https://doi.org/10.1016/j.cmet.2025.01.015>

I original abstract; fetched record lacked abstract. Macro-matched healthy-adult randomized trial; no verified sample/effect magnitude here; PMID 40043690.

**[18] Berry et al.(2020). Human postprandial responses and precision nutrition.**

<https://doi.org/10.1038/s41591-020-0934-0>

I original abstract/sections. PREDICT 1 rich measured inputs and cohort validation; declared commercial interests, not Nutrikom-model validation; PMID 32528151.

**[19] Meng et al.(2017). Prior-meal composition and subsequent GI/GL responses.**

<https://doi.org/10.3945/ajcn.117.162727>

A. 20 healthy participants; standardized 4-hour second-meal challenge, not an automatic contextual correction; PMID 28903959.

## Bibliography — timing and measurement boundaries

**[20] Gu et al.(2020). Metabolic effects of late dinner in healthy volunteers.**

<https://doi.org/10.1210/clinem/dgaa354>

F publisher targeted full text. 20-person randomized crossover; sleep and dinner/snack schedule controlled; acute effects, no chronic weight proof; PMID 32525525.

**[21] Morris et al.(2015). Endogenous circadian system and misalignment affect glucose tolerance.**

<https://doi.org/10.1073/pnas.1418955112>

F targeted original PMC text. 14 adults; two 8-day controlled protocols. Source-defined phase, no clock-only personal prediction; PMID 25870289.

**[22] Bandín et al.(2015; online 2014). Meal timing, glucose tolerance and circadian variables.**

<https://doi.org/10.1038/ijo.2014.182>

A. 32 women across 2 protocols, glucose subgroup 10; later lunch may also alter prior-meal interval; PMID 25311083.

**[23] Garaulet et al.(2022). Dinner timing, MTNR 1B and glucose tolerance/insulin secretion.**

<https://doi.org/10.2337/dc21-1314>

A. 845 adults; bedtime-relative 75 g OGTT after 8-hour fast, not a mixed dinner; PMID 35015083.

**[24] McHill et al.(2017). Later circadian food timing and body fat.**

<https://doi.org/10.3945/ajcn.117.161588>

I original abstract. 110 young adults; cross-sectional circadian-timing association, no causal single-meal suitability result; PMID 28877894.

**[25] Peddie et al.(2013). Breaking prolonged sitting and postprandial glycaemia.**

<https://doi.org/10.3945/ajcn.112.051763>

A directly accessed PubMed abstract. 70 healthy normal-weight adults, activity patterns vs sitting; no individual exercise credit; PMID 23803893.

**[26] Gentilcore et al.(2006). Fat, gastric emptying and carbohydrate response in type 2 diabetes.**

<https://doi.org/10.1210/jc.2005-2644>

A original Mahidol abstract. Six men with type 2 diabetes; oil/water before or oil within a potato meal; INDIRECT for healthy adults; PMID 16537685.

**[27] Abell et al.(2008). ANMS/SNM consensus recommendations for gastric-emptying scintigraphy.**

<https://doi.org/10.2967/jnmt.107.048116>

I original institutional report/metadata; full direct page inaccessible. Standardized diagnostic test/reference meal, not arbitrary-meal digestion prediction.

**[28] NIDDK. Your Digestive System & How It Works.**

<https://www.niddk.nih.gov/health-information/digestive-diseases/digestive-system-how-it-works>

F institutional educational explanation. Digestion/absorption/transit definitions, not a numerical time model; public page reviewed December 2017.

**[29] Wolever et al.(2017). Glycemic index is as reliable as macronutrients on food labels.**

<https://pubmed.ncbi.nlm.nih.gov/28251938/>

I original methodological correspondence, not a new human trial. Challenges conflation of individual-response variability and mean food GI precision.

## Evidence, UX proposals and final disposition

**Prior project documents:** [D 1] DAY01; [D 2] REC01; [D 3] REF01, 11 October 2026, v 1.0. Full text retrieved, including the REF01 continuation. Their scope/missingness/reference boundaries are inherited; they are project syntheses, not independent primary evidence for physiology.

### Material disagreements and uncertainty

| Finding                                                              | Consequence                                                                                                                                                                                                                   |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GI can explain selected meal means, yet misestimate complete meals   | Keep GI-based descriptors separate from physiological prediction. Ranking, calibration and individual prediction error are different properties.                                                                              |
| Macronutrient additions differ by food/dose/person                   | No universal protein/fat/fibre attenuation formula. A lower glucose endpoint may coincide with greater insulin, or no measurable change at tested doses.                                                                      |
| Satiety and glucose directions can diverge                           | Subjective appetite, gut hormones, emptying and later energy intake are distinct. Do not build a guaranteed chain from lower glucose to less hunger or weight loss.                                                           |
| Time matters under controlled conditions; clock-only judgement fails | Use prior intake, sleep and activity as optional context. Report observational evidence as association; do not convert the 15:00 label into a biological phase.                                                               |
| Clinical studies are indirect                                        | Type 2 diabetes fat-preload evidence helps illustrate mechanism but does not supply healthy-adult dosing advice. Insulin-treated diabetes, motility disease, bariatric surgery and relevant medicines require separate scope. |

### Disposition

| Decision            | Action                                                                                                                                                                                                                                                                              |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ADOPT FOR DESIGN    | Composition facts first; short conditional mechanisms; distinct measured outcomes; optional context/food ideas; server-controlled figures/attribution; fact/evidence-linked AI; useful local fallback; explicit unknown states and revision checks.                                 |
| INVESTIGATE FURTHER | GI source/matching coverage and available-carbohydrate definitions; conditional calculated GL and its comprehension; culturally relevant food examples; digital appetite self-report; independent numerical error and applicability evaluation if a prediction feature is proposed. |
| DEFER               | Personal glucose/insulin forecasts, macro-derived satiety ratings, digestion-time clocks, universal snack/time suitability and harmful-spike verdicts. No deficiency diagnosis, supplement prescription or Nutrikom Index validation.                                               |

### UX hypotheses to test

Test whether adults understand composition versus response, “calculated” versus “measured”, missing GI versus zero, and subjective fullness versus later intake. Check whether conditional wording is read as a hidden personal warning. Evaluate food-idea relevance, cultural fit, accessibility, numerical literacy and local-fallback usefulness. The 30 verification cases specify expected behaviour; they do not constitute executed tests or clinical validation.