



Differences in postprandial blood glucose levels and satiety after consumption of local foods “nasi kuning” and “songkolo” in young adult women

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ABSTRAK

Latar Belakang: Prevalensi diabetes melitus dan obesitas terus meningkat, termasuk di Indonesia, sementara data glikemik pangan lokal masih terbatas. Respons glukosa darah postprandial dan rasa kenyang merupakan dua determinan utama regulasi metabolik yang sangat dipengaruhi oleh komposisi pangan dan metode pengolahannya. Nasi Kuning dan Songkolo merupakan pangan pokok lokal yang populer di Sulawesi Selatan namun profil glikemik dan efeknya terhadap rasa kenyang belum banyak diteliti secara ilmiah, sehingga data ini penting untuk mendukung edukasi gizi berbasis pangan lokal..

Tujuan: Penelitian ini bertujuan membandingkan glukosa darah postprandial dan rasa kenyang setelah konsumsi Nasi Kuning dan Songkolo pada wanita dewasa muda.

Metode: Desain penelitian adalah kuasi-eksperimental dengan perbandingan sekuensial dalam subjek pada 12 wanita sehat usia 18-22 tahun, masing-masing mengonsumsi 25 g karbohidrat tersedia dari tiap pangan uji pada dua sesi terpisah dengan jeda washout 3 hari. Glukosa darah diukur pada menit ke-0, 30, 60, dan 120, dan rasa kenyang dinilai dengan VAS empat dimensi (lapar, kenyang, keinginan makan, prospective consumption).

Hasil: Songkolo menghasilkan puncak glukosa darah yang lebih tinggi secara signifikan ($141,50 \pm 20,94$ mg/dL) dibandingkan dengan Nasi Kuning ($121,75 \pm 23,42$ mg/dL) pada menit ke-30 ($F = 11,728$, $p = 0,006$). Tidak ditemukan perbedaan signifikan antara pangan pada dimensi rasa kenyang di setiap titik waktu ($p > 0,05$), meskipun kedua pangan menunjukkan perubahan temporal yang signifikan.

Kesimpulan: Songkolo menghasilkan glukosa darah postprandial yang lebih tinggi secara signifikan dibandingkan dengan Nasi Kuning, tanpa perbedaan signifikan pada rasa kenyang. Nasi kuning berpotensi menjadi pilihan karbohidrat yang lebih baik untuk pengendalian glikemik.

KATA KUNCI: glukosa darah postprandial; nasi kuning; pangan lokal; rasa kenyang; songkolo

ABSTRACT

Background: The prevalence of diabetes mellitus and obesity continues to rise worldwide, including in Indonesia, while glycemic data on local foods remain limited. Postprandial blood glucose response and satiety are two key determinants of metabolic regulation that are substantially influenced by food composition and processing methods. Nasi Kuning and Songkolo are popular local staple foods in South Sulawesi, yet their glycemic and satiety profiles remain scientifically underexplored.

Objectives: This study aimed to compare postprandial blood glucose and satiety after consumption of Nasi Kuning and Songkolo in young adult women.

Methods: A quasi-experimental within-subject sequential design was employed with 12 healthy female subjects aged 18-22 years, each consuming a standardized 25 g available carbohydrate portion of each test food on two occasions separated by a 3-day washout. Blood glucose was measured at 0, 30, 60, and 120 minutes, and satiety was measured using a four-dimension Visual Analogue Scale (VAS). Data were analyzed using Two-Way Repeated Measures ANOVA and Friedman/Wilcoxon Signed-Rank tests..

Results: Songkolo produced a significantly higher peak blood glucose level (141.50 ± 20.94 mg/dL) compared to Nasi Kuning (121.75 ± 23.42 mg/dL) at 30 minutes postprandially ($F = 11.728$, $p = 0.006$). No significant inter-food differences were observed in any satiety dimension at any time point ($p > 0.05$), although both foods elicited significant within-food temporal changes.

Conclusions: Songkolo elicited a significantly higher postprandial blood glucose response than Nasi Kuning, with no significant difference in satiety. Nasi Kuning may be a more metabolically favorable carbohydrate choice for glycemic control.

KEYWORDS: local food; nasi kuning; postprandial blood glucose; satiety; songkolo

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INTRODUCTION

According to worldwide data from the International Diabetes Federation in 2024, the prevalence of adult diabetes mellitus aged 20-79 years was 11.1%, and undiagnosed cases were almost 44.7% (1,2). The National Health Survey (SKI) 2023 in Indonesia reported a prevalence of obesity of 23.4% in adults, with the increasing prevalence of diabetes mellitus. National data from Riskesdas indicate a substantial rise in diabetes mellitus prevalence in Indonesia, from 6.9% in 2013 to 10.9% in 2018 among the population aged ≥ 15 years, with women showing a higher physician-diagnosed prevalence (1.8%) than men (1.2%), further increasing to 11.7% in 2023 according to the Indonesia Health Survey (SKI) (25,3). Moreover, the prevalence of physician-diagnosed diabetes mellitus in South Sulawesi was 1.5%, increasing to 3.7% in urban Makassar and 2.6% in Maros Regency, indicating an ongoing dietary and lifestyle transition (3). Postprandial blood glucose regulation is a central component of metabolic homeostasis and is substantially influenced by the characteristics of carbohydrate-containing foods consumed. After a

carbohydrate meal, blood glucose rises, typically peaking within 30 to 60 minutes and returning to near-fasting levels within two hours in metabolically healthy individuals (4).

The magnitude and duration of this postprandial glycemic excursion are determined by food matrix properties, including starch structure, dietary fiber content, and cooking methods, and their interaction with digestive physiology (5). Recurrent uncontrolled postprandial hyperglycemia has been associated with oxidative stress, endothelial dysfunction, and progressive development of insulin resistance, metabolic syndrome, type 2 diabetes mellitus, and cardiovascular disease (6). Beyond these metabolic consequences, the pattern of postprandial glycemic fluctuation may also influence short-term appetite regulation, as glucose excursions and subsequent declines modulate satiety signaling (7). At the same time, satiety, which is defined as the subjectively perceived feeling of fullness and the physiological state of appetite suppression after food intake, is an important determinant of energy intake

regulation (8). The magnitude and duration of satiety after a meal are important factors that determine the inter-meal interval and the amount of energy consumed at the subsequent meal, which are directly relevant when considering energy balance and long-term metabolic health (8). Satiety is affected by several factors, including gastric distension, hormonal signaling (e.g., glucagon-like peptide-1, GIP, and ghrelin), and the postprandial glycemic response curve; rapid glycemic excursions and precipitous drops in glucose levels may promote a faster return of hunger (7).

In this context, there is an urgent need to evaluate the metabolic effects of locally consumed staple foods, especially those for which validated glycemic data are not available. Rice-based local staple foods still dominate the daily dietary patterns across many regions of Indonesia, including South Sulawesi. (9). Nasi Kuning (yellow rice cooked with coconut milk and turmeric) and Songkolo (steamed glutinous rice traditionally served with serundeng) are two of the most popular local foods (10). Candidate foods were identified from five commonly consumed local staples in South Sulawesi, followed by a preliminary consumption-frequency survey among young adult female students using an online questionnaire (Google Form). Nasi Kuning and Songkolo were selected as the two most frequently consumed staples from this survey, with 79.1% of respondents consuming Nasi Kuning at least 2–3 times per month and only 33.3% reporting they had never consumed Songkolo, compared to higher non-consumption rates for the other candidate foods, informing both their ecological relevance and the contrast in starch matrix needed for comparison. These two foods differ fundamentally in starch composition and preparation: Nasi Kuning is made with regular white rice with a moderate amylose content (about 20-25%), whereas Songkolo is made with glutinous rice, which contains more than 98% amylopectin (11).

Previous research has consistently shown that rice varieties with higher amylopectin-to-amylose ratios, such as glutinous rice, exhibit higher glycemic responses than rice with higher amylose content because of faster starch digestibility (12,13). Cooking and processing

methods further modulate this response, with boiling time and preparation technique shown to influence postprandial glucose levels (14,15) significantly. International glycemic index (GI) databases are dominated by processed and commercial foods (5,16) with limited representation of the Indonesian local staple foods (17). This study therefore evaluated differences in postprandial blood glucose levels and satiety after consuming Nasi Kuning and Songkolo in young adult women, providing a scientific basis for carbohydrate food selection to support metabolic health.

MATERIALS AND METHODS

This study employed a quasi-experimental within-subject sequential comparison design, in which each subject received both test foods in a fixed sequence (Nasi Kuning first, followed by Songkolo after a 3-day washout), serving as their own control. As the objective was to directly compare the postprandial glycemic response between the two test foods rather than to determine their standardized glycemic index, no pure glucose reference load was administered. This research was conducted at STIKes Salewangang Maros, Maros Regency, South Sulawesi, Indonesia, in March 2026. The research has received ethical approval from the Institutional Review Board of Universitas Muslim Indonesia (No. 370/A.1/KEPUMI/IV/2026). A total of 12 subjects were recruited according to the ISO 26642:2010 standards (18), which require a minimum of 10 subjects for within-subject repeated measures glycemic designs. Additionally, the large effect size for food type (partial $\eta^2 = 0.516$) confirmed that the sample size was sufficient to detect meaningful differences in the primary glycemic outcome.

Subjects were recruited via purposive sampling, a non-probability technique selecting participants based on predetermined criteria aligned with the study objective (24). Candidates were female university students aged 18–30 years from STIKes Salewangang Maros, selected after screening 45 candidates. This technique was chosen because it allowed efficient screening for the specific eligibility profile required (normal fasting glucose, non-smoking, healthy status), which broader probability sampling would not

efficiently capture within the available recruitment window. Of the 45 initially screened candidates, exclusions were primarily due to fasting blood glucose above the normal threshold (<126 mg/dL) and unwillingness to commit to the full two-session protocol with a 3-day washout period; 12 candidates met all eligibility criteria and voluntarily completed the study (Figure 1). Recruitment was not extended to 15–20 participants due to practical constraints: each subject required two testing sessions separated by a mandatory 3-day washout period, and data collection was limited to a fixed window in March 2026, making it infeasible

to enroll and complete testing for additional eligible subjects within the available timeframe. Inclusion criteria were: (1) female student aged 18–30 years; (2) normal fasting blood glucose (< 126 mg/dL); (3) no history of diabetes mellitus or use of glucose-altering medications; and (4) willingness to complete the full study protocol. Subjects outside the ISO-recommended BMI range were retained as the within-subject design controls for metabolic variability. Exclusion criteria were failure to complete the food portion or absence at either session).

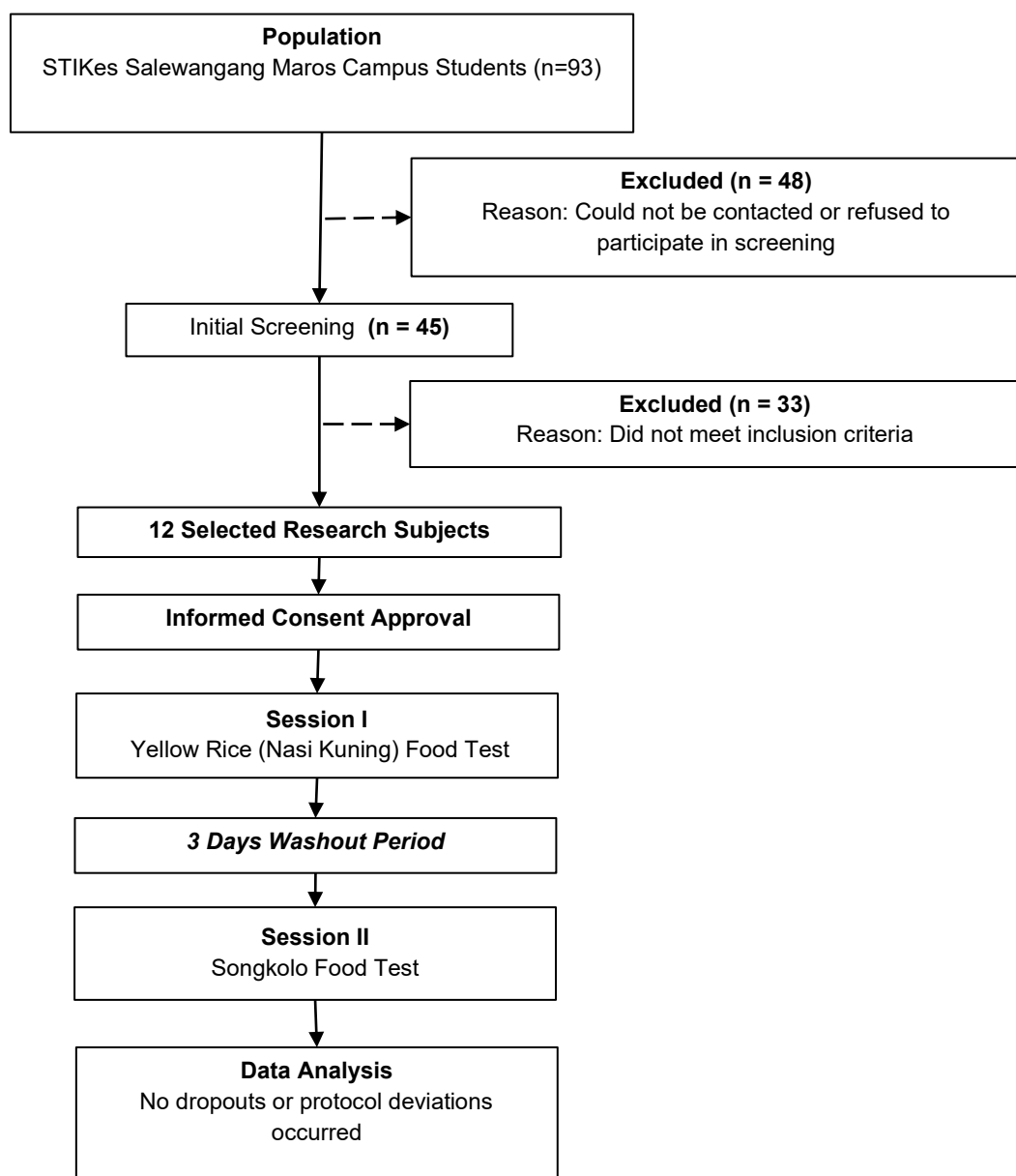


Table 1. Articles that met the inclusion criteria

Nasi Kuning and Songkolo were selected based on a dietary frequency survey. The portions were standardized to contain 25 g of available carbohydrate, calculated by subtracting the total dietary fiber from the total carbohydrate content according to the Indonesian Food Composition Table (TKPI) and verified using NutriSurvey software. Standardization yielded one serving of Nasi Kuning (69 g wet weight) and one serving of Songkolo (47 g wet weight). Nasi Kuning was prepared from 27.7 g white rice cooked with 34.5 mL instant coconut milk, lemongrass, and bay leaf. Songkolo was prepared from 29 g glutinous rice cooked with 14 mL instant coconut milk. No added sugar was used in either preparation.

Participants were not permitted any other side dishes, condiments, or foods during the testing sessions. We served a standard volume of 220 mL of plain water with each test food. Capillary blood samples were taken at 0, 30, 60, and 120 minutes post-food using a Sinocare® Safe-Accu glucometer with single-use reagent strips. Subjects fasted 8-10 hours before each session and were instructed to avoid strenuous activity, caffeine, and high-sugar foods for 24 hours before each session. All food was consumed within 10-15 minutes. Subjective satiety was assessed at 0, 30, 60 and 120 min using a 100-mm Visual Analogue Scale (VAS) questionnaire, validated by Blundell et al. (8).

Four dimensions of satiety were measured: hunger, fullness, desire to eat and prospective consumption. Higher hunger and desire-to-eat scores indicate higher appetite; higher fullness and lower prospective consumption indicate higher satiety. At each time point, participants rated each dimension on a separate 100-mm VAS line, and the score was determined by measuring the distance (in mm) from the left end of the line to the point marked by the participant using a ruler. This resulted in four VAS scores per time point for each food condition, yielding 16 VAS scores per food (four dimensions × four time points) and 32 VAS scores per participant across the two sequential food sessions (Nasi Kuning and Songkolo).

We used the Shapiro-Wilk test to assess normality. Sphericity was evaluated using Mauchly's test; the Greenhouse-Geisser correction was applied when it was violated. Blood

glucose was analyzed using Two-Way Repeated Measures ANOVA (food type, time, food × time interaction); effect sizes were reported as partial η^2p , which represents the proportion of variance in the dependent variable explained by each factor, independent of other factors in the model; values were interpreted as small ($\eta^2p = 0.01$), medium ($\eta^2p = 0.06$), and large ($\eta^2p = 0.14$) (19). We analyzed satiety VAS data using the Friedman test (within-food) and the Wilcoxon Signed-Rank test (between-food). Significance was set at $p < 0.05$ (IBM SPSS Statistics). We calculated the incremental area under the postprandial blood glucose curve (iAUC) using the trapezoidal method, including only positive increments above the individual fasting baseline value; negative increments were set to zero (14). We compared differences in iAUC between foods using the Wilcoxon Signed-Rank test.

RESULT AND DISCUSSIONS

Twelve female subjects completed all study sessions. **Table 1** presents their baseline characteristics. The majority (75%) were aged ≥ 19 years. Body mass index (BMI) ranged from 15.76 to 26.99 kg/m². Mean BMI was 21.20 ± 3.40 kg/m², with three subjects classified as underweight (BMI < 18.50) and three as overweight (BMI 25.00-29.90); the remaining six subjects were within the normal range (18.50-24.90). Fasting blood glucose ranged from 66.00 to 99.00 mg/dL. The considerable inter-individual variability in BMI and fasting blood glucose reflects the natural heterogeneity typically observed in healthy young adult populations. Given this variability, the within-subject sequential design was particularly important, as each participant served as their own control across both food conditions, minimizing the influence of inter-individual differences in baseline metabolic status on the comparison between Nasi Kuning and Songkolo.

Furthermore, using the incremental area under the curve (iAUC) and Δ baseline values, rather than absolute glucose concentrations alone, further accounted for individual differences in fasting glucose levels. Using only female subjects ensured inter-subject homogeneity, given established sex-related differences in insulin sensitivity and body composition, particularly

skeletal muscle mass, the primary tissue for insulin-mediated glucose disposal (15).

Postprandial Blood Glucose Response

Figure 2 illustrates the mean postprandial blood glucose levels for both test foods at all time points. At time zero, baseline testing showed that there was no significant difference in fasting blood glucose levels between the Nasi Kuning (91.50 ± 14.40 mg/dL) and Songkolo (98.67 ± 8.75 mg/dL)

sessions ($p > 0.05$), implying that the metabolic starting point was uniform for both intervention periods. Peak blood glucose concentrations occurred 30 minutes postprandially for both foods, with a gradual decline at 60 and 120 minutes. Songkolo consistently produced higher blood glucose levels than Nasi Kuning across all postprandial time points, with the greatest absolute difference at 30 minutes ($\Delta = 19.75$ mg/dL).

Table 1. Baseline Characteristics of Study Subjects (n = 12)

Code	Age (yrs)	BW (kg)	Height (cm)	BMI (kg/m ²)	FBG (mg/dL)
R1	21	63.00	164.50	23.61	95.00
R2	19	52.70	158.00	21.11	85.00
R3	22	63.90	158.00	25.60	98.00
R4	18	53.40	151.00	23.42	89.00
R5	20	65.80	160.50	25.70	90.00
R6	19	60.00	161.70	22.95	98.00
R7	20	45.20	162.50	17.12	99.00
R8	20	68.40	159.20	26.99	97.00
R9	20	42.90	165.00	15.76	98.00
R10	18	42.90	155.00	17.86	99.00
R11	18	44.10	150.80	19.39	66.00
R12	20	46.80	144.60	22.38	90.00

BW = Body Weight; BMI = Body Mass Index; FBG = Fasting Blood Glucose.

The results of the Two-Way Repeated Measures ANOVA were as follows. A statistically significant effect of food type was found ($F=11.73$, $p=0.006$), which indicates that Songkolo induced a significantly higher overall blood glucose response than Nasi Kuning. Time also had a highly significant effect ($F=39.47$, $p < 0.00$), indicating significant temporal changes in blood glucose concentrations across measurement points. However, the food $\times$ time interaction was

not significant ($F=1.32$, $p=0.29$), indicating that the two foods followed a parallel glycemic trajectory although they differed in magnitude. The effect sizes were large for both food type (partial $\eta^2 = 0.52$) and time (partial $\eta^2 = 0.78$), indicating that each factor independently influenced blood glucose levels rather than acting through a combined or interactive effect. The food $\times$ time interaction was not statistically significant and had a smaller effect size (partial $\eta^2 = 0.11$).

Table 2. Incremental Area Under the Curve (iAUC) of Postprandial Blood Glucose

iAUC (mg/dL min), Median (IQR)		p-value
Nasi Kuning	Songkolo	
1665.00 (963–2295)	2282.50 (1608–3390)	0.27

Note: Values are expressed as mean $\pm$ SD ($n = 3$), mg/100 g wet basis. GC-FID determined fatty acid composition. The $\omega 6:\omega 3$ ratio is shown as an indicator of fatty acid balance. No inferential statistical analyses were performed.

This further supports that food type and time affected glucose concentrations separately rather than jointly. The post hoc pairwise comparisons using Bonferroni correction revealed that blood glucose concentrations were significantly different

at all adjacent time points: 0 vs. 30 min ($p < 0.00$), 0 vs. 60 min ($p = 0.00$), 30 vs. 60 min ($p < 0.00$), 30 vs. 120 min ($p < 0.00$), and 60 vs. 120 min ($p = 0.04$). The only non-significant pair was 0 vs. 120 min ($p = 0.13$), suggesting that postprandial blood

glucose had generally returned to near-fasting levels at 120 min after consuming both foods.. Complementary analysis of iAUC revealed that Songkolo produced a numerically higher median glycemic exposure compared to Nasi Kuning 2282.50 (IQR: 1608–3390) vs. 1665.00 (IQR: 963–2295) mg/dL min); however, this difference did not reach statistical significance ($Z = -1.098$, $p = 0.27$). Eight of twelve participants (66.7%) exhibited higher iAUC values following Songkolo consumption, a directional pattern consistent with the peak glucose findings (**Table 2**). Although the iAUC comparison did not reach statistical significance ($p = 0.27$), a consistent directional pattern was observed, with 8 of 12 participants demonstrating higher iAUC values following Songkolo consumption. This finding suggests numerically greater overall glycemic exposure following Songkolo, although substantial inter-individual variability may have contributed to the absence of a statistically significant between-food difference. As shown in **Figure 2**, Values are expressed as Mean $\pm$ SD ($n = 12$). Both foods showed peak blood glucose concentration at 30

minutes postprandial, followed by a gradual decrease at 60 and 120 minutes. Songkolo showed consistently higher blood glucose levels than Nasi Kuning at all postprandial time points ($F = 11.728$, $p = 0.006$, Two-Way Repeated Measures ANOVA). The food $\times$ time interaction was non-significant ($F = 1.317$, $p = 0.286$), indicating parallel glycemic trajectories differing in magnitude. Error bars represent standard deviation. The higher glycemic response produced by Songkolo is biologically explained by the starch composition of its primary ingredient, glutinous rice. Glutinous rice contains greater than 98% amylopectin (11), a highly branched starch molecule whose numerous branch points provide multiple simultaneous cleavage sites for salivary and pancreatic amylases. This structure enables rapid hydrolysis to glucose and quick absorption into the bloodstream, leading to a higher and earlier glycemic peak (15). Nasi Kuning, however, is made from normal white rice, which contains about 20-25% amylose, a linear starch molecule with a denser, more tightly packed structure that digests more slowly (12).

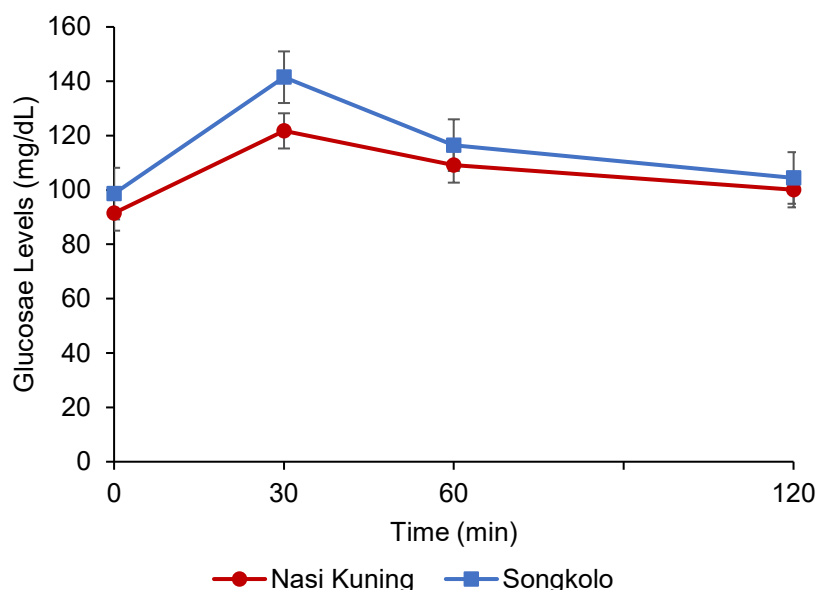


Figure 2. Mean ($\pm$ SD) postprandial blood glucose responses following consumption of Nasi Kuning (NK) and Songkolo (SK) over 120 minutes ($n = 12$)

This is comparable to findings from other Indonesian local staple foods; for instance, Trisna et al. (26) reported that corn-based local foods exhibited high glycemic indices, attributable to

their starch content and cooking method, while other glutinous rice-based traditional foods across Southeast Asia have similarly demonstrated elevated glycemic responses due to high

amylopectin content (13). These cross-regional comparisons support the generalizability of amylose-to-amylopectin ratio as a primary determinant of postprandial glycemic response across diverse local staple foods. Both foods were cooked with coconut milk, which contributes saturated fatty acids that can theoretically slow gastric emptying and blunt glycemic response (20). However, the results indicate that coconut milk's lipid-moderating effect was insufficient to overcome the dominant influence of amylopectin structure in Songkolo. This finding is consistent with Wu et al. (21), who stated that amylopectin content is the most dominant modifiable factor in postprandial glycemic response, exceeding the effects of lipid-mediated gastric emptying. Farooq and Yu (13) reported the same findings, confirming that glutinous rice varieties always give higher glycemic responses than normal rice varieties, regardless of processing and cooking methods. These findings have direct clinical and public health relevance. However, interpret this conclusion with caution, as real-world consumption of Nasi Kuning and Songkolo typically involves co-consumption with protein-rich

side dishes (e.g., fried egg, shredded chicken, or fish) rather than carbohydrate alone, as tested in this study. Co-consuming protein with carbohydrate has been shown to attenuate postprandial glycemic response by delaying gastric emptying and stimulating insulin secretion (27). Therefore, the glycemic differences observed here likely represent an upper-bound estimate under isolated carbohydrate conditions, and future studies incorporating habitual meal combinations are needed to determine whether the between-food difference persists, is attenuated, or is eliminated under realistic dietary patterns (22). From a carbohydrate-food-choice perspective, Nasi Kuning may be a more metabolically favorable choice than Songkolo for people who need to control glycemic response, including those with prediabetes, type 2 diabetes mellitus, or metabolic syndrome (22). The standardization of 25 g available carbohydrate in this study follows ISO 26642:2010 and the methodology of Brouns et al. (14,18), ensuring that observed differences reflect intrinsic food matrix characteristics rather than serving-size variability)

Table 3. Postprandial satiety visual analogue scale (vas) scores, median (q1–q3), by time point.

Satiety dimension	Time (min)	Median (Q1- Q3)		p*	p (NK)**	p (SK)**
		Nasi Kuning	Songkolo			
Hunger	0	77.50 (45.30-100.00)	77.00 (52.00-92.50)	0.556		
	30	34.50 (15.80-64.00)	42.50 (32.30-67.80)	0.195		
	60	53.50 (33.50-66.50)	72.00 (56.00-77.80)	0.060		
	120	68.00 (58.00-92.80)	75.00 (69.30-86.80)	1.000	0.001	0.003
Fullness	0	17.50 (0.30-57.00)	19.50 (6.50-57.30)	0.504		
	30	66.00 (28.00-81.80)	55.00 (35.00-71.50)	0.929		
	60	37.00 (25.20-70.20)	32.50 (18.80-39.00)	0.135		
	120	21.50 (14.50-61.50)	32.50 (24.20-52.20)	0.844	0.020	0.058
Desire to eat	0	79.00 (48.00-100.00)	72.00 (50.30-90.80)	0.563		
	30	48.50 (22.30-70.30)	59.50 (40.00-68.80)	0.724		
	60	60.50 (38.00-76.30)	75.00 (63.30-78.80)	0.071		
	120	70.50 (57.80-89.00)	85.00 (76.00-90.80)	0.131	0.020	0.003
Prospective consumption	0	68.00 (41.00-83.80)	60.50 (41.30-86.00)	0.583		
	30	44.50 (28.50-54.30)	53.00 (38.80-64.50)	0.505		
	60	53.00 (43.20-66.20)	63.00 (50.50-77.80)	0.195		
	120	71.00 (48.00-84.00)	75.00 (60.00-87.80)	0.477	0.095	0.034

* p-value from Wilcoxon Signed-Rank Test (between-food comparison at each time point)

** p-value from Friedman Test (within-food temporal change over 120 minutes) NK = Nasi Kuning; SK = Songkolo

Postprandial Satiety Response

Postprandial satiety was assessed at 0, 30, 60, and 120 minutes using a 100-mm Visual Analogue Scale (VAS) across four dimensions: hunger, fullness, desire to eat, and prospective consumption. Between-food differences at each time point were evaluated using the Wilcoxon Signed-Rank Test, while within-food changes over the 120 minutes were assessed using the Friedman Test. The resulting median (Q1- Q3) VAS scores for each dimension, time point, and food are summarized in Table 3). Both foods produced the expected postprandial satiety pattern: hunger, desire to eat, and prospective consumption decreased from baseline, while fullness increased, with all four dimensions reaching their most pronounced postprandial state at 30 minutes. Scores for hunger, desire to eat, and prospective consumption progressively recovered toward baseline values by 120 minutes, while fullness scores correspondingly declined. Subjective satiety was assessed at 0, 30, 60, and 120 min using a 100-mm Visual Analogue Scale (VAS) questionnaire. Each dimension was scored on a 100-mm scale (0-100), anchored by opposing extremes (e.g., hunger: 0 = "not at all hungry" to 100= "extremely hungry"; fullness: 0= "not at all full" to 100= "extremely full"). Higher hunger, desire to eat, and prospective consumption scores indicate greater appetite, while higher fullness scores indicate greater satiety (8). No statistically significant differences were detected between Nasi Kuning and Songkolo in any of the four satiety dimensions at any time point (all $p > 0.05$, Wilcoxon Signed-Rank Test) (Table 3). Nevertheless, within-food temporal changes were significant for both foods in hunger, desire to eat, and fullness for Nasi Kuning, and for Songkolo in prospective consumption (Friedman Test), confirming real and meaningful satiety dynamics over the 120-minute observation period.

First, the macronutrient profiles of the two foods were similar: both were predominantly carbohydrate-based and used coconut milk as a common ingredient, leading to similar gastric distension and hormonal satiety signaling following similar carbohydrate intake (23). Second, the standardized 25 g available carbohydrate serving size was methodologically necessary for valid glycemic comparison but was

significantly smaller than habitual serving sizes of the two foods, resulting in a floor effect whereby all subjects experienced residual appetite capacity regardless of food type. Third, the subjective nature of VAS and the relatively small sample ($n = 12$) may have limited statistical power to detect subtle between-food differences in satiety given the acknowledged high inter-individual variability of satiety perception (8).

Although not statistically significant, trends followed the expected direction. Nasi Kuning elicited a higher fullness score at 30 minutes (median: 66.00) than Songkolo (55.00), likely because the larger physical volume for an equivalent carbohydrate portion led to greater gastric distension and stronger mechanoreceptor-mediated satiety signals (8). Songkolo, being prepared from the denser glutinous rice grain, had a smaller physical volume for the equivalent available carbohydrate content. At 120 minutes, subjects reported higher hunger scores following Songkolo consumption (75.00) than following Nasi Kuning consumption (68.00), higher desire to eat scores (85.00 vs. 70.05) and higher prospective consumption scores (75.00 vs. 71.00), suggesting an earlier return of appetite motivation after Songkolo consumption, a pattern consistent with the glycemic-satiety link described by Wyatt et al (7).

Postprandial glycemic dips within a 2-hour postprandial window, especially after high-GI foods, have been shown to reliably predict increased appetite and food intake (7). The pattern observed in this study, in which Songkolo produced a sharper glycemic peak at 30 min followed by a greater return of appetite at 120 min, is mechanistically consistent with this framework. Future studies with larger sample sizes and extended observation periods (up to 180-240 minutes) are warranted to characterize the satiety-glycemic relationship of these local foods more precisely.

Study Limitation

This study has several limitations that warrant acknowledgment. First, the sample size of 12 subjects, while consistent with within-subject sequential comparison glycemic methodology (14,18), limited statistical power for detecting subtle between-food satiety differences using non-

parametric tests. Second, subjects could not be blinded to the test food because Nasi Kuning and Songkolo differed visually, aromatically, and texturally, which could introduce expectation bias and affect VAS responses. Third, the 120-minute observation period is a standard timeframe for postprandial blood glucose assessment and may not have been sufficient to capture divergent satiety trajectories, which may emerge beyond 120-180 minutes, particularly for high-GI foods. Fourth, the BMI distribution of the study sample was heterogeneous, with three underweight and three overweight subjects.

However, although the within-subject design controls for inter-individual metabolic differences, the sample does not fully represent a homogeneous healthy-weight population as recommended by ISO 26642:2010. Fifth, the non-significant iAUC finding ($p = 0.272$) should be interpreted with caution, as large inter-individual variability in fasting blood glucose was observed, especially for one participant who had a subnormal session fasting baseline of 59 mg/dL, which disproportionately increased the incremental area for the Nasi Kuning session and likely lessened the difference between foods. Sixth, the fixed sequential administration of test foods rather than randomized counterbalancing may have introduced order effects, especially for VAS satiety scores, as subjects may have been more familiar with the scale during the second session, which deviates from true crossover methodology.

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CONCLUSION AND RECOMMENDATION

Postprandial blood glucose response to Songkolo was significantly higher than that to Nasi Kuning ($F = 11.728$, $p = 0.006$), possibly due to the high amylopectin content of glutinous rice, which may have overshadowed the glycemic-moderating effects of coconut milk. Postprandial satiety showed no statistically significant differences between foods, although directional

trends indicated an earlier return of appetite with Songkolo. These findings provide baseline metabolic characterizations of local staple foods to inform dietary guidance for women seeking stable glycemic regulation. Therefore, when consuming Songkolo, it is advisable to incorporate high-fiber side dishes or additional protein sources to help moderate rapid postprandial glucose absorption.

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