JCHS
Journal of Clinical and Health Sciences
#2
2026

SUPPLEMENTARY ISSUE

Malaysian Obesity Society
MYOS

2ND NATIONAL OBESITY SCIENTIFIC CONFERENCE

ABSTRACT BOOK

11th - 12th April 2026
Connexion Conference & Event Centre,
Kuala Lumpur, Malaysia

Theme
Obesity as a Treatable Chronic Disease: Science, Strategy, and Success

Issue **September** 2026 | Volume **11** Issue **02 (Supplementary)**
eISSN 0127-984x
jchs-medicine.uitm.edu.my
Universiti Teknologi MARA

Journal of Clinical and Health Sciences, Vol 11 Issue 2(Supplementary) 2026
The 2nd Malaysian Obesity Society (MYOS) National Obesity Scientific Meeting (NOSC)
Obesity as a Treatable Chronic Disease: Science, Strategy and Success, 11th – 12th April 2026
https://doi.org/10.24191/jchs.v11i2.13578

OR-7

Modified Breakfast Using a Diabetes-Specific Formula Improves Postprandial Inflammation and Metabolic Flexibility in People Living with Obesity and Type 2 Diabetes

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Introduction:
Postprandial inflammation is a key driver of metabolic deterioration in people living with obesity and Type 2 Diabetes (T2DM). The metabolic impact of a recommended standard diabetes breakfast, typically focused on carbohydrate exchanges, remains poorly characterised. This study compared the acute metabolic responses to a Modified Diabetes Breakfast (MDB) containing a diabetes-specific formula (DSF) with those to the standard meal, using a Meal Challenge Test (MCT) and untargeted metabolomics to explore modulation of postprandial inflammation and metabolic flexibility, the body's ability to switch between carbohydrate and fat oxidation

Methods:
Twenty adults living with obesity and T2DM completed two randomised crossover MCTs one week apart, consuming either a Standard Diabetes Breakfast (SDB) or the MDB. The MDB replaced part of the carbohydrate content with a DSF enriched in high-quality protein, unsaturated fat, fibre, and micronutrients. Blood samples were obtained at fasting, 60-min, and 240-min post-meal. Serum metabolites were profiled using H-NMR-based untargeted metabolomics, and paired analyses identified differential postprandial signatures.

Results:
Thirteen metabolites were significantly modulated post-meal. At 60-min, the MDB significantly elicited lower concentration of glucose ($p=0.022$), glutamine ($p=0.04$), lactate ($p=0.016$), and betaine ($p=0.044$), compared with the SDB: These metabolites are linked to glycolysis, amino-acid and methyl-donor pathway that controlling energy and inflammatory responses. Overall, the SDB modulated 13 metabolites without demonstrating protective effects. Whereas, the MDB regulated 10 metabolites, including one unique marker (isoleucine) linked to anti-inflammatory and insulin-sensitising activity.

Conclusion:
The MDB incorporating a diabetes-specific formula achieved a protective postprandial metabolic profile by dampening glucose and lactate excursions and improving amino-acid clearance, key hallmarks of enhanced insulin sensitivity and greater metabolic flexibility. In contrast, the SDB amplified inflammatory and oxidative metabolite responses. These findings provide novel metabolomic evidence that DSF-based breakfast modification can attenuate postprandial inflammation and help interrupt the metabolic cycle that perpetuates insulin resistance and obesity in T2DM.