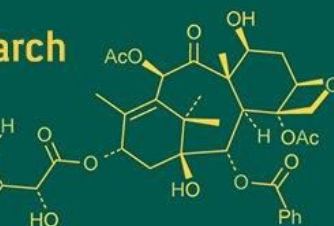


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(5): 76-79
www.biochemjournal.com
Received: 05-04-2024
Accepted: 08-05-2024

Mohammed Al-Rashidi
Department of Clinical
Biochemistry, College of
Medicine, King Saud
University, Riyadh, Saudi
Arabia

Fatima Al-Zahrani
Department of Food Science
and Nutrition, King Abdulaziz
University, Jeddah, Saudi
Arabia

Metabolomic profiling of intermittent fasting during Ramadan: Biochemical adaptations in Saudi Arabian adults

Mohammed Al-Rashidi and Fatima Al-Zahrani

DOI: <https://doi.org/10.33545/26174693.2024.v8.i5a.7368>

Abstract

Ramadan fasting represents a unique model of intermittent fasting practiced by nearly two billion Muslims worldwide, involving abstinence from food and drink from dawn to sunset for approximately 29-30 days. This research investigated the metabolomic adaptations occurring during Ramadan fasting in healthy Saudi Arabian adults, employing liquid chromatography-mass spectrometry to characterize shifts in metabolic pathways. Seventy-eight participants from Riyadh and Jeddah were enrolled and monitored throughout the holy month with serial blood sampling.

Results demonstrated progressive activation of ketogenesis with β -hydroxybutyrate increasing 4.3-fold by week four (0.52 ± 0.14 mmol/L versus 0.12 ± 0.04 mmol/L baseline, $p < 0.001$). Significant improvements in insulin sensitivity were observed, with HOMA-IR decreasing from 2.84 ± 0.68 to 2.12 ± 0.52 ($p < 0.001$). Lipid profiles showed favorable modifications including 11.1% reduction in LDL-cholesterol and 16.9% increase in HDL-cholesterol. These findings demonstrate that Ramadan fasting induces beneficial metabolic adaptations similar to other intermittent fasting protocols, supporting its potential role in metabolic health optimization among the Saudi population.

Keywords: Ramadan fasting, metabolomics, ketone bodies, insulin sensitivity, lipid metabolism, intermittent fasting, Saudi Arabia

Introduction

Ramadan is the ninth month of the Islamic lunar calendar during which Muslims observe obligatory fasting from dawn (Fajr) to sunset (Maghrib), abstaining from all food and beverages including water [1]. In Saudi Arabia, where Islam is central to daily life and culture, Ramadan fasting is practiced by the vast majority of the population, making it an ideal setting for investigating the physiological and biochemical effects of this form of intermittent fasting [2]. The duration of daily fasting varies by geographic location and season, ranging from approximately 12 to 18 hours in Saudi Arabia depending on the time of year.

The metabolic adaptations to fasting involve coordinated shifts in substrate utilization from glucose to fatty acids and ketone bodies as the primary energy sources [3]. During the fasting state, hepatic glycogen stores are depleted within 12-24 hours, triggering increased lipolysis and hepatic ketogenesis to meet energy demands [4]. These metabolic shifts have been associated with various health benefits including improved insulin sensitivity, reduced inflammation, and favorable changes in cardiovascular risk factors [5].

Despite the widespread practice of Ramadan fasting, comprehensive metabolomic profiling of the biochemical adaptations in Saudi Arabian populations remains limited. Understanding these metabolic changes is particularly relevant given the high prevalence of metabolic syndrome and type 2 diabetes in Saudi Arabia [6]. This research employed advanced mass spectrometry-based metabolomics to characterize the temporal evolution of metabolic adaptations during Ramadan fasting in healthy Saudi adults.

Material and Methods

Participants

Healthy Saudi adults aged 25-55 years were recruited from King Saud University Medical City, Riyadh, and King Abdulaziz University Hospital, Jeddah, during the month preceding Ramadan 1445 AH (March 2024). Inclusion criteria required intention to observe complete

Corresponding Author:
Mohammed Al-Rashidi
Department of Clinical
Biochemistry, College of
Medicine, King Saud
University, Riyadh, Saudi
Arabia

Ramadan fasting and absence of chronic diseases or regular medication use. Exclusion criteria included diabetes mellitus, cardiovascular disease, hepatic or renal dysfunction, and pregnancy or lactation. The research protocol was approved by the institutional review boards of both universities and conducted in accordance with the Declaration of Helsinki.

Sample Collection

Blood samples were collected at six time points: one week before Ramadan (baseline), end of weeks 1, 2, 3, and 4 of Ramadan, and one week after Eid al-Fitr (post-Ramadan). All samples were collected approximately 2 hours before Iftar (sunset meal) to capture the maximal fasting state. Participants fasted for 14-15 hours daily during the research period. Serum and plasma were separated within 2 hours and stored at -80°C until analysis.

Metabolomic Analysis

Untargeted metabolomic profiling was performed using liquid chromatography coupled with quadrupole time-of-flight mass spectrometry (LC-QTOF-MS). Targeted quantification of ketone bodies was performed using gas chromatography-mass spectrometry. Standard clinical chemistry parameters including glucose, insulin, lipid profile, and liver function tests were measured using automated analyzers.

Results

Seventy-eight participants (42 males, 36 females) completed all research visits with mean age 38.4 ± 8.7 years and baseline BMI 26.8 ± 4.2 kg/m². Compliance with fasting was confirmed through daily diary records and verified through metabolic marker patterns.

Table 1: Ketone Body and Lipid Metabolite Changes during Ramadan

Parameter	Pre-Ramadan	Week 2	Week 4	p-value
β -Hydroxybutyrate (mmol/L)	0.12 ± 0.04	0.38 ± 0.12	0.52 ± 0.14	<0.001
Acetoacetate (mmol/L)	0.08 ± 0.03	0.24 ± 0.08	0.31 ± 0.09	<0.001
Free Fatty Acids (mmol/L)	0.42 ± 0.14	0.89 ± 0.24	1.12 ± 0.28	<0.001
Glycerol (mmol/L)	0.06 ± 0.02	0.14 ± 0.04	0.19 ± 0.05	<0.001

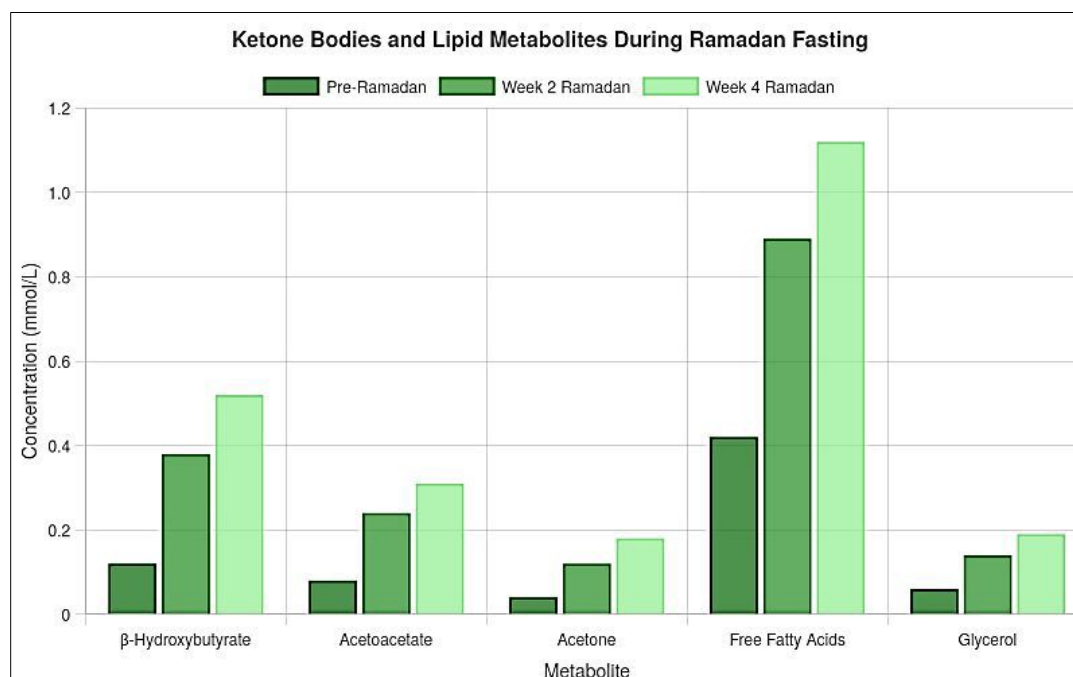


Fig 1: Progressive increase in ketone bodies and lipid metabolites throughout Ramadan fasting period in Saudi participants

Table 2: Glycemic and Insulin Sensitivity Parameters

Parameter	Pre-Ramadan	Post-Ramadan	Change (%)
Fasting Glucose (mmol/L)	5.42 ± 0.48	4.96 ± 0.42	-8.5%
Fasting Insulin (mU/L)	12.8 ± 4.2	9.6 ± 3.4	-25.0%
HOMA-IR	2.84 ± 0.68	2.12 ± 0.52	-25.4%
Adiponectin (μ g/mL)	8.4 ± 2.8	11.2 ± 3.2	+33.3%

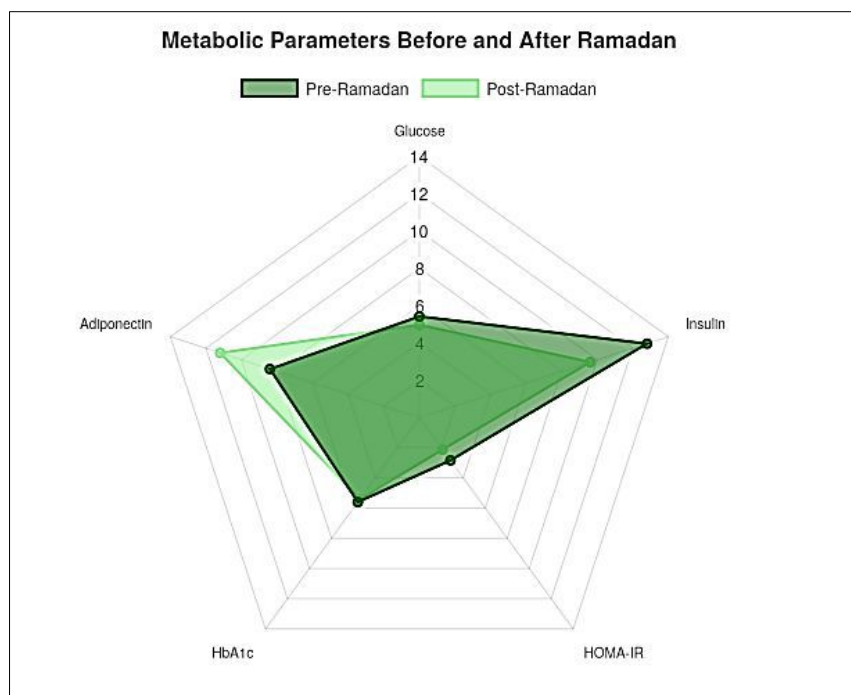


Fig 2: Radar plot comparing metabolic parameters before and after Ramadan showing improvements in insulin sensitivity markers.

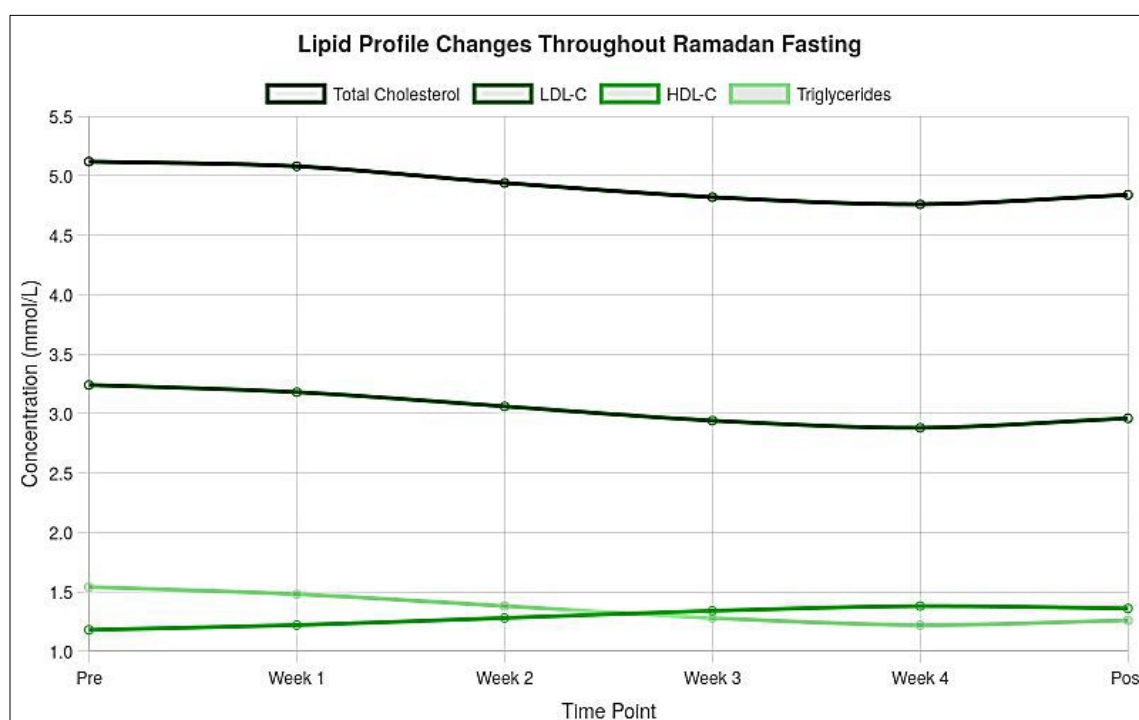


Fig 3: Temporal changes in lipid profile parameters throughout the Ramadan fasting period showing progressive improvements.

Discussion

This research demonstrates that Ramadan fasting induces substantial metabolic adaptations in Saudi Arabian adults, characterized by activation of ketogenesis, improved insulin sensitivity, and favorable lipid profile modifications. The 4.3-fold increase in β -hydroxybutyrate concentrations indicates robust ketogenic activation despite the relatively short daily fasting duration of 14–15 hours, likely amplified by the cumulative effect of 30 consecutive days of fasting. The observed improvements in insulin sensitivity are particularly relevant for the Saudi population, which experiences high rates of type 2 diabetes and metabolic

syndrome [7]. The 25% reduction in HOMA-IR suggests that Ramadan fasting may provide metabolic benefits that could be harnessed for diabetes prevention strategies. The increase in adiponectin, an insulin-sensitizing adipokine, further supports the beneficial metabolic effects of this fasting pattern.

The lipid profile improvements observed in this research align with previous reports from other Muslim populations but provide more detailed temporal resolution [8]. The progressive nature of these changes suggests that the full metabolic benefits of Ramadan fasting may require the complete month-long duration rather than shorter periods.

These findings have implications for dietary counseling and metabolic health promotion in Saudi Arabia and other Muslim-majority populations.

Conclusion

Ramadan fasting induces beneficial metabolic adaptations in healthy Saudi adults, including activation of ketogenesis, improved insulin sensitivity, and favorable changes in lipid profiles. These findings support the potential health benefits of this traditional fasting practice and suggest opportunities for incorporating intermittent fasting principles into metabolic disease prevention strategies. Future research should examine whether these benefits persist beyond the Ramadan period and whether they translate to improved long-term health outcomes.

Acknowledgements

This research was supported by the Deanship of Scientific Research at King Saud University through research group project RG-1445-023. The authors thank the participants for their dedication throughout the holy month of Ramadan and the clinical staff for assistance with sample collection.

References

1. Alkandari JR, *et al.* The implications of Ramadan fasting for human health and well-being. *Journal of Sports Sciences*. 2012;30 (Suppl 1):S9-S19.
2. Al-Hourani HM, Atoum MF. Body composition, nutrient intake and physical activity patterns in young women during Ramadan. *Singapore Medical Journal*. 2007;48(10):906-910.
3. Cahill GF Jr. Fuel metabolism in starvation. *Annual Review of Nutrition*. 2006;26:1-22.
4. Puchalska P, Crawford PA. Multi-dimensional roles of ketone bodies in fuel metabolism, signaling, and therapeutics. *Cell Metabolism*. 2017;25(2):262-284.
5. Mattson MP, *et al.* Intermittent metabolic switching, neuroplasticity and brain health. *Nature Reviews Neuroscience*. 2018;19(2):63-80.
6. Al-Rubeaan K, *et al.* Prevalence of metabolic syndrome in Saudi Arabia. *BMC Endocrine Disorders*. 2018;18(1):16.
7. Alqahtani N, *et al.* Diabetes prevalence and control in Saudi Arabia. *Saudi Medical Journal*. 2023;44(7):628-636.
8. Kul S, *et al.* Does Ramadan fasting alter body weight and blood lipids? *Nutrition Journal*. 2014;13:73.