

## Effects of Ramadan Fasting on Some Haematological and Biochemical Parameters

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### Abstract

Ramadan is the month during which Muslims refrain from food, liquids and smoking during daylight hours and eat a large meal after sundown. This custom provides a unique opportunity to study the biochemical changes over Ramadan time. The study was performed on 57 healthy females and was carried out in the month of Ramadan (October- November 2004). Blood samples were collected four times: one week before the beginning of Ramadan, at the end of the first week, at the end of the second week, and at the end the last week of Ramadan. Haematological indices including haemoglobin, hematocrit, red blood cell count, and platelets count were determined twice (one week before Ramadan and mid of Ramadan) on whole blood samples. Serum was evaluated for creatinine, urea, albumin, uric acid, and lipids (triglycerides), total cholesterol, high density lipoprotein (HDL-C) and low density lipoprotein- cholesterol (LDL-C) was calculated.

Haematologically, platelets count was significantly decreased ( $p = 0.002$ ) during Ramadan while other parameters remained relatively stable. Biochemical analysis showed a significant reduction in serum triacylglycerols (TAGs) after the mid of Ramadan ( $p = 0.007$ ). A slight but not significant increase ( $p=0.073$ ) in HDL-C was observed. The changes in the other parameters were not significant. In Jordanian healthy females, Ramadan fasting resulted in a statistical effect on platelets count and serum triglycerides.

### المخلص

أجريت هذه الدراسة على 57 من الإناث اللواتي لا يعانين من مشاكل صحية خلال شهر رمضان 2004 وقد تم جمع عينات الدم من المشاركات على أربع فترات الأولى قبل بداية شهر رمضان والثانية في الأسبوع الأول من الشهر و الثالثة في منتصف الشهر والرابعة في نهايته. وقد تم تقدير الهيموجلوبين والهيماتو كريت وعدد كريات الدم الحمراء والصفائح الدموية قبل بداية شهر رمضان وفي منتصفه بالإضافة إلى تقدير كمية الكرياتينين واليوريا والاليومين وحمض البوليك والجليسريدات الثلاثية والكوليسترول الكلي والكوليسترول عالي الكثافة ومنخفض الكثافة. وإشارات النتائج إلى انخفاض ملحوظ في عدد الصفائح الدموية خلال شهر رمضان وانخفاض في والجليسريدات الثلاثية بعد منتصف الشهر مع عدم حدوث تغيرات معنوية على المؤشرات الأخرى.

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### 1. Introduction

Ramadan is the holiest month in the Islamic calendar (The Holy Quran). Fasting in this month is one of the five pillars of Islam. Fasting is obligatory for all adults and

healthy Muslims during the day hours for the whole month every year. Ramadan month occurs 11 days earlier every year due to the difference between the solar and lunar years, and may occur in any of the four seasons, making the length of fasting hours variable from 11-18 hours in tropical countries (Sakr, 1975). Ramadan is the month during which Muslims refrain from food, liquids and tobacco smoking during daylight hours and eat a main meal after sundown. Free eating is allowed from sunset to

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dawn. Ramadan teach Muslims self-restraint and remind them of the feelings of the impoverished. Ramadan is observed by over 400 million of Muslims who spread across the globe; and live under various geographical, climatic, social, cultural and economic conditions. This provides a unique opportunity to study the haematological and biochemical changes over Ramadan time.

Effect of Ramadan on biochemical parameters is still a matter of debate. Energy intake decreases during Ramadan (Sweileh *et al.* 1992). Several studies have reported on the effect of Ramadan fasting on the values of certain haematological factors (El-Hazmi *et al.* 1987; Azizi and Rasouli 1986; Al Tufail *et al.* 1992; Sarraf *et al.* 2000; Ramadan, 2002). Changes in serum urea and creatinine were small (El-Hazmi *et al.* 1987; Sliman and Khatib 1988). Serum uric acid showed a slight increase (El-Hazmi *et al.* 1987; Azizi and Rasouli 1986; Gumaa *et al.* 1987; Ramadan *et al.* 1994). Concerning serum protein levels, an increase was demonstrated for total proteins (El-Hazmi *et al.* 1987; Ramadan *et al.* 1994; Aybak *et al.* 1996) and albumin (El-Hazmi *et al.* 1987)

Ramadan Islamic fasting is an excellent model of how dietary modifications may affect serum total cholesterol (TC), triacylglycerols (TAGs), low density lipoprotein – cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C). Effect of Ramadan fasting on serum lipid profile is not so clear; some studies record improvements in serum profile, while others show deterioration within healthy subjects (Hussain *et al.* 1987; Maislos *et al.* 1998; Adlouni *et al.* 1998; Bilito, 1998; Rahman *et al.* 2004; Ziaee *et al.* 2006; Asgary *et al.* 2000). The aim of the present study is to evaluate the effect of Ramadan fasting on some haematological and biochemical parameters on healthy young females.

## 2. Material and Method

This study was performed during Ramadan of October – November 2004 (Hijri year 1425). The subjects were students of The Hashemite University in Jordan. All subjects were interviewed; a questionnaire was used to collect data regarding age, marital status, and medical history. Non-healthy volunteers were excluded. Volunteers gave informed consent for participation in the study.

Venous blood was taken one week before Ramadan (T1), first week of Ramadan (T2), and second week of Ramadan (T3), and last week of Ramadan (T4) after an average fast of eight hours. Anthropometric measurements were performed at the same time of blood sampling. Blood was collected in plain and EDTA tubes. Serum was obtained by low speed centrifugation at 1000g for 15 minutes, and samples were immediately separated into aliquot and stored at -20C until analysis. All serum samples were analyzed in a single batch to avoid day-to-day laboratory variation. Haematological and biochemical measurements took place in the Research Laboratory for the department of medical laboratories at The Hashemite University. Fresh EDTA blood was used to determine haematological parameters using Cell – Tac  $\alpha$  (Nihon-Kohden, Japan)

Serum total cholesterol (TC) and high density lipoprotein– cholesterol (HDL-C) were measured by an enzymatic colorimetric method using cholesterol oxidase,

peroxidase, and the chromogen 4-aminophenazone/phenol Allain *et al.* 1974. Serum triacylglycerols (TAGs) levels were determined by an enzymatic colorimetric method using lipoprotein lipase glycerokinase, glycerophosphate oxidase, and the chromogen 4-aminophenazone/N-ethyl-N (3-sulphopropyl)-nramisidine (Fossati, 1982). Low-density lipoprotein – cholesterol (LDL-C) was calculated using Friedwald *et al.* equation (Friedwald *et al.* 1972).

Urea, Serum albumin and uric acid were quantitatively estimated in serum by enzymatic colorimetric test. Creatinine was determined using JAFFE method by commercially provided kits provided by Biocon diagnostic (Germany)

All data were expressed as mean  $\pm$  standard deviation (SD). Paired t-test was used to compare pre and during Ramadan fasting variables. ANOVA was used to analyze repeated measures. Differences were considered significant when *p* values were less than 0.05. All analysis was performed using the statistical package (SPSS) version 10.0 (Chicago, IL, USA).

## 3. Results

Fifty-seven healthy volunteer females were included in this study. The mean age of the subjects was 21.6 years (ranging from 18 to 29, SD 4.14). No significant changes were observed in haemoglobin, hematocrit, and red blood cell count values before and during Ramadan fasting. Platelets was decreased significantly during Ramadan compared to before Ramadan (*P*= 0.002) as shown in Table 1.

Table 1. Hematological indices of the subjects.

Haematological indices	Before Ramadan	During Ramadan	<i>P</i> value
Red blood cell count (x 106/mm3)	4.30 $\pm$ 0.69	4.43 $\pm$ 0.37	0.16
Hemoglobin gm/dl	12.3 $\pm$ 2.0	12.3 $\pm$ 1.3	0.935
Hematocrit %	35.8 $\pm$ 4.1	36.0 $\pm$ 3.3	0.697
Platelets (1000)	165.1 $\pm$ 66.0	126.9 $\pm$ 80.3	0.002

Data are mean  $\pm$  SD

Table 2 showed no significant changes in serum creatinine, urea, albumin and uric acid values during Ramadan fasting compared to that before Ramadan.

Results of the effect of Ramadan fasting on plasma lipids are shown in Table 3. A significant reduction of serum triglycerides was observed after the mid of Ramadan (*p* = 0.007). A slight but not significant increase (*p*=0.073) in HDL – C was observed. No significant changes were observed on total cholesterol and LDL – C.

## 4. Discussion

During the fasting month of Ramadan, Muslims are obliged to fast during daytime hours and restrict food and drink intake to the period after sunset. Long lasting modifications in the circadian distribution of the eating and sleeping schedule result in various changes in metabolism. This will provide a unique opportunity to study the effect

Table 2. Serum creatinine, urea, albumin and uric acid.

	T1	T2	T3	T4
Creatinine (mg/dl)	0.73 ± 0.21	0.78 ± 0.29	0.70 ± 0.16	0.75 ± 0.29
Urea (mg/dl)	23.2 ± 7.9	23.7 ± 6.2	21.4 ± 6.2	20.4 ± 5.9
Albumin (mg/dl)	4.7 ± 0.58	4.7 ± 0.47	4.7 ± 0.49	4.7 ± 0.81
Uric acid (mg/dl)	5.8 ± 3.8	5.5 ± 2.7	5.2 ± 3.0	5.7 ± 4.2

Data are mean ± SD

Table 3. Plasma lipids and lipoprotein levels.

	T1	T2	T3	T4
Total Cholesterol (mg/dl)	157.9 ± 33.2	154.8 ± 26.8	155.4 ± 37.9	154.1 ± 28.2
Triacylglycerols (mg/dl)	88.3 ± 62.5	70.7 ± 24.1	62.9 ± 24.6 <sup>1</sup>	65.4 <sup>2</sup> ± 20.8
HDL Cholesterol (mg/dl)	59.3 ± 9.5	57.8 ± 11.4	58.8 ± 13.1	62.3 <sup>3</sup> ± 14.6
LDL Cholesterol (mg/dl)	81.7 ± 26.4	84.5 ± 24.9	88.8 ± 33.3	83.4 ± 29.9

Data are mean ± SD

<sup>1</sup>  $p = 0.007$ , <sup>2</sup>  $p = 0.052$ , <sup>3</sup>  $p = 0.073$

meal frequency reduction on haematological and biological indices.

Studies reported in literature on the effect of Ramadan fasting on various haematological indices have been conflicting and inconsistent. In this study, red blood cells count, haemoglobin and hematocrit remained unchanged, which was consistent with (Azizi and Rasouli 1986; Sarraf *et al.* 2000; Azizi, 2002). Although, other studies showed a slight degree of hemoconcentration (El-Hazmi *et al.* 1987). Conversely, Dewanti *et al.* (2006) showed a significant decrease in haemoglobin and hematocrit. These controversial results may be due to geographical, climatic, economical, and nutritional variations. This study showed a significant reduction in the platelets count, which was consistent with Ramadan *et al.*, (1994) this may due to deficit or redistribution of specific micronutrients (iron and vitamins) that may account for reduction in platelets count (Ramadan *et al.* 1999).

Many previous studies have been published on the effect of Ramadan fasting on serum creatinine and urea in healthy individuals and reported small changes that were statistically not significant. The results of this study were consistent with the previous studies (El-Hazmi *et al.* 1987; Sliman and Khatib 1988; Mafauzy *et al.* 1990; Aksunger *et al.* 2005).

Studies on serum uric acid among healthy individuals showed normal to temporary slight increase that doesn't deviate from normal range, which is probably due to decrease in glomerular filtration rate and uric acid clearance (Azizi, 2002). The results of this study showed no significant increase in the level of uric acid despite a significant weight loss of the subjects (Al Hourani and Atoum 2007), which could be explained either by body fat loss rather than catabolism of body cell mass or by the

nature of Ramadan fasting which is short lasting and intermittent.

To best of our knowledge, none of the previous studies reported an alteration in serum albumin among healthy individuals (Azizi and Rasouli 1986; Maislos *et al.* 1998). No significant changes in serum albumin detected in the results of this study, which was consistent with the previous reports.

Many reports have been published on the effect of Ramadan fasting on blood lipids among healthy individuals, with inconsistent and even conflicting findings. The discrepancy might be attributed to the amount and type of food intake, physical activity, ethnic, and genetic background of studied populations.

In line with the reports of Asgary *et al.* (2000) and Mahboob *et al.* (1999), we found a significant decrease in serum triacylglycerols after mid of Ramadan. The reduction in serum triacylglycerols can be explained either by changes in fat intake or inherent metabolic changes during Ramadan. In previous report (Al Hourani and Atoum, 2007) we found that fat intake during Ramadan was similar to pre Ramadan in healthy young Jordanian females; therefore, our explanation is in favour with the fact that inherent metabolic changes during Ramadan may lower serum triglycerides.

Concerning levels of serum total cholesterol, LDL-cholesterol, and HDL-cholesterol, the changes were not statistically significant. However, most previous studies on HDL cholesterol showed a significant increase in plasma HDL cholesterol (Maislos *et al.* 1998; Rahman *et al.* 2004; Maislos *et al.* 1993; Fakhrzadeh *et al.* 2003; Adlouni *et al.* 1997). Plasma concentration of HDL is a protective factor against the development of atherosclerosis and cardiovascular diseases and usually quite stable. Since we

have observed a gradual increase in HDL cholesterol during Ramadan which didn't reach a significant level over the period of one month fasting, our results are in accord with the previous reports that showed an elevation of plasma HDL cholesterol levels. Although, mechanism(s) by which fasting increases level of HDL cholesterol are not clear, loss of weight in the studied population may increase HDL-Cholesterol.

In conclusion, Ramadan fasting is a healthy non-pharmacological method for improving lipid profile. In view of the fact that many factors influence the effect of Ramadan fasting on haematological and biochemical parameters; we recommend a large – scale coordinated studies, with standardization of research methods regarding the season, gender, food habits, and ethnic background of the subjects, to explore the issue more comprehensively.

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