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BODY WEIGHT AND SOME BIOCHEMICAL CHANGES ASSOCIATED WITH RAMADAN FASTING IN HEALTHY SAUDI MEN

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ABSTRACT

Body weight, total daily energy intake as well as biochemical parameters of serum glucose, total cholesterol, high and low density lipoprotein cholesterol, total protein and uric acid were measured in a group of 45 volunteers of Saudi Arabia healthy Muslim men at pre and at the end of Ramadan (The Muslim month of fasting).

Body weight, total daily energy intake and the qualitative compounds of nutrients were significantly ($P<0.05$) decreased at the end of Ramadan. There was a significant ($P<0.05$) decrease in the levels of serum glucose, serum total protein and serum triglyceride. In contrast, there was a significant increase ($P<0.05$) in serum uric acid. There were no significant changes in the levels of serum total cholesterol, high and low density of lipoprotein cholesterol.

It was concluded that Ramadan fasting could induce weight loss through restriction in diet and energy intake with consequent little changes in some biochemical parameters. These changes were within normal reference range of pre Ramadan values and appear to be reversible.

Key words: *energy intake, fasting, lipid profile.*

1. INTRODUCTION

Ramadan fasting one of the five pillars of Islam is the ninth

lunar month of Islamic calendar. At Ramadan month Muslims, abstain from food and liquid from dawn to sunset. The common practice is to eat one large meal after sunset and an optional lighter meal before dawn. Ramadan teaches Muslims self-restraint and reminds them of the feelings of the impoverished. Ramadan fasting has bean described in detail by Sakr (1975).

Despite the importance and worldwide nature of this religious practice, only few studies of metabolism implications of Ramadan fasting have been published (Gumaa *et al.*, 1978; Fedail *et al.*, 1982; Frost and Pirani, 1987; Husain *et al.*, 1987; Maislos *et al.*, 1993 and Afrasiabi *et al.*, 2003).

Different results have been reported on the effect of Ramadan fasting on changes in body weight (Fedail *et al.*, 1982; and Afrasiabi *et al.*, 2003) and body mass index (BMI) (Fedail *et al.*, 1982; Maislos *et al.*, 1993) as well as serum total cholesterol (TC), triglyceride (TG), low density lipoprotein-cholesterol (LDL-C), and high density lipoprotein-cholesterol (HDL-C) (Maislos *et al.*, 1993; Bilto, 1998; Afrasiabi *et al.*, 2003). Gumaa *et al.* (1978) reported that serum uric acid concentration increased with the days of fasting, also serum protein concentration increased with Ramadan fasting (Ramadan, 1994), in contrast blood glucose decreased (Bilto, 1998 and Roky *et al.*, 2004).

Ramadan fasting provides an excellent opportunity to study the effect of a prolonged reduction of meal frequency on body weight, total energy intake and body metabolism.

The present study was carried out to compare body weight, total energy intake and the biochemical changes of serum glucose, protein, uric acid, triglycerides and lipoproteins of healthy subjects at pre-Ramadan fasting with the end of it.

2. MATERIALS AND METHODS

This current study was conducted on forty-five volunteer healthy men (age rang 30-45) in Ramadan (fasting month for Muslim) during 2004, in Buraidah, one of the main cities of Qassim region, Saudi Arabia. The study started one week before Ramadan and ended in the fourth week of the month.

Men on medication to control their blood lipid or any medicines with influence the metabolism of lipid factors, and those who smoke were excluded from this study.

Food plastic models, were used to help them to estimate the serving size for daily food intake. Daily food intake for three non consecutive days (2 week day and one week end day) one week before Ramadan (Pre-Ramadan) and other three in the fourth week of Ramadan (End-Ramadan) were recorded in the forms provided to them. Food processor, plus program software, 2003 was used to analyze daily food record and to calculate the mean energy, carbohydrate, protein and fat intakes. Some traditional meal not being included in the above program was included with regard to Saudi table of traditional meals.

Body weight and blood samples of the participants were taken one day before Ramadan and in the 28^{th} on the month. Trained staff collected blood samples and measured the body weight of the volunteers. Body weight was measured to the nearest "100g" with subject in light clothes and without shoes. The weighing scale used was "Health 0 meter' lever type (made in USA). This scale was zeroed before and after every measurement.

During Ramadan, the venous blood samples were collected at mid day after 10-12 hours fasting (after shahor, the meal before dawn), and before Ramadan blood samples were collected after 10-12 hours of abstention of any food and drinking.

The blood samples were allowed to clot and serum was separated and stored at (-20°C). Stored samples were analyzed for glucose, total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein-cholesterol (LDL-C), triglycerides (TG), total protein and uric acid concentrations by using Roche/Hitachi 917 auto analyzer and Roche reagent kits for automated analysis (Roche Diagnostics GmbH, D-68298 Mannheim) as follow:

- Glucose was converted to glucose-6-phosphate by hexokinase and ATP then oxidized to gluconate-6-phosphate by glucose 6-phosphate dehydrogenase in the presence of NADP. The rate of NADPH formation during the reaction is directly proportional to the glucose concentration and can be measured photometrically according to Kaplan (1987).
- Cholesterol was determined enzymatically using cholesterol esterase and cholesterol oxidase. Cholesterol was converted by oxygen with the aid of cholesterol oxidase to cholest-4-en-3-one and hydrogen peroxide. The hydrogen peroxide created forms a red dyestuff by reacting with 4-amino-phenazone and phenol under the catalytic action of peroxidase. The colour intensity is directly

proportional to the concentration of cholesterol which can be determined photometrically by the method of Naito (1987).

- HDL-C in serum was assayed directly by automated method using polyethylene glycol-modified enzyme and dextrain sulfate according to the method of Sugluchi *et al.* (1995).
- LDL-C in human serum was assayed directly by homogenous enzymatic assay using the method of Bachoric (2000).
- Triglyceride was determined by enzymatic colorimetric test according to the method of Stein and Myers (1995).
- Total serum protein was assayed using buiret reagent. The colour intensity is directly proportional to the protein concentration, which could be determined photometrically by using the method of Koller (1987).
- Uric acid was determined after oxidized to allenatoine and hydrogen peroxide in the presence of 4-amino pheazone dye to give red colour, which is proportional to the concentration of uric acid (Kageyama, 1971).

2.1. Data analysis

Analysis of data was performed using Statistical Package for the Social version 1.0 (SPSS) computer software. Descriptive statistics were used to display data in means ±SD. The statistical method of paired t-test was used to compare the differences in energy, carbohydrate, protein and fat intakes, serum glucose, serum lipid profile, total protein, uric acid and body weight before and at the end of Ramadan. Differences were considered significant whenever the p-value is ($P<0.05$).

3. RESULTS

Table (1) shows the changes in the average daily energy intake at the end of Ramadan compared with the pre-Ramadan values. It was significantly ($P<0.05$) reduced from 2150±183 kcal pre-Ramadan to 1910±90 kcal at the 28th day of Ramadan fasting.

The average daily reduction in energy intake was 240±43 kcal (11.2%). However, the qualitative analysis of food eaten showed that the total energy drived from carbohydrates, protein and fats were significantly ($P<0.05$) reduced by 11.4%, 14.2% and 7.8%, respectively at the end of Ramadan compared with the pre-Ramadan values.

Table (2) shows the changes in body weight and the biochemical parameters determined during Ramadan. When the results were compared with the pre-Ramadan values, there was a significant ($P<0.05$) decrease in body weight from: 85.5±3.9 kg at pre-Ramadan to 83.2±3.3 kg at the end of Ramadan.

Plasma lipoprotein analysis (pre-Ramadan vs end of Ramadan, respectively) revealed that TC (5.2±0.72 and 5.16±0.67 mmol/L) LDL-C (2.96±0.44 and 2.92±0.42 mmol/L) and HDL-C (1.79±0.25 and 1.82±0.25 mmol) did not change significantly.

Serum TG concentrations were significantly ($P<0.05$) reduced at the end of Ramadan (1.2±0.51 mmol/L) than at pre-Ramadan (1.48±0.55 mmol /L), and also, serum glucose and total protein were significantly ($P<0.05$) decreased to 4.51±0.5 mmol/L and 67.1±2.9 g/L, respectively, at the end of Ramadan compared with 4.91±0.52 and 68.2±2.7 g/L, respectively at pre-Ramadan.

Table(1): Effect of Ramadan fasting on energy, carbohydrate, protein and fat daily intakes.

Variables	Pre-Ramadan*	End-Ramadan**	Reduction values	Reduction (%)
Energy (kcal)	2150.0(±133.0)	1910.0(±90.0)***	240.0±43.0	11.2
Carbohydrate (g)	350.0(±24.0)	310.0(±12.0)***	40.0±2.3	11.4
Protein (g)	70.0(±4.0)	60.0±(4.2)***	10.0±0.8	14.2
Fat (g)	55.0(±4.6)	51.0(±3.1)***	4.0±0.28	7.8

(values are mean±SD n=45)

* Average of three days one week before Ramadan non consecutive.

** Average of three non consecutive days in the fourth week of Ramadan.

*** Significant ($P<0.05$) compare to Pre-Ramadan values.

In contrast, serum uric acid concentration was significantly ($P<0.05$) increased to 0.29±0.2 mmol/L at the end of Ramadan compared with 0.25±0.1 mmol/L at pre-Ramadan.

The calculated (pre-Ramadan vs. the end of Ramadan) ratios of TC to HDL-C were 2.96±0.50 vs. 2.94±0.31 and of LDL-C to HDL-C were 1.65±0.32 vs. 1.60±0.22.

4. DISCUSSION

Since the metabolic consequences of fasting during Ramadan are not clearly known, it was interested to investigate lipid, total

protein, uric acid and lipoprotein metabolism to determine which parameters are most affected by fasting during Ramadan.

In the present study, the decreased total daily energy intake during Ramadan (240.0±43.0 Kcal) is due to the decrease in the intake of carbohydrates (40.0±2.3g), proteins (10.0±0.8g) and fats (4.0±0.28g) by 11.4, 14.2 and 7.8%, respectively compared with pre-Ramadan. Our findings agree with Chandalia *et al.* (1987) who showed a decrease of daily energy intake in Indian Moslems during Ramadan fasting. Also, Khan and Muzaffar (2002), mentioned that the average daily energy intake was reduced by 857±41 kcal in the month of fasting.

However, the present results contradict those showing an increase of the total energy intake in Saudi subjects during Ramadan fasting (Frost and Pirani, 1987) and also, those reported in Tunisian subjects which showed no change in the total daily energy intake (El-Ati *et al.*, 1995).

The present finding of an average weight loss of 2.3 kg (*i.e.* 2.69%) at the 4th week of fasting (Table 2) coincides with the findings of other reports (Husain *et al.*, 1987; Suliman and Khatib, 1988 and Takruri, 1989) in which the loss of weight ranged from 1.2% to 3.5% and the percentage of loss being greater in overweight persons.

The loss of weight accompanied by a significant ($P<0.05$) decrease in serum glucose (Table 2) could be explained as a result of energy intake restriction induced by fasting. These results are in accordance with the finding of Nicholls and Scott (1972) who induced weight loss through restriction of energy intake. These authors proposed that their findings could be partly due to the relative hydration associated with weight loss. In the same respect Khan and Muzaffar (2002) mentioned that the adaptive mechanism of the body for preservation of water during fasting may have an effect on food intake. Usually fasting individuals are thirsty, and they drink a lot of fluids at the Iftar time, leaving little room in their stomach for regular food and this causes a significant reduction in caloric intake estimated by 857±410 kcal/day and a loss of the average body weight about 3.2±1.7 kg during the month of fasting.

Other researches suggested that the decrease in body weight during Ramadan fasting could be attributed to the decrease in fluid intake (Gumaa *et al.*, 1978; Sweileh *et al.*, 1992).

In this study, serum glucose was significantly ($P<0.05$) decreased during Ramadan fasting (4.51±0.52 mmol/L) in comparison

to the control day before Ramadan fasting (4.91±0.50 mmol/L). This result may be due to energy intake restriction induced by fasting. However, several studies (El-Arnoaty and Johnson, 1991; Chong *et al.*, 1993, and Maislos *et al.*, 1998) demonstrated that fasting glucose did not change during Ramadan fasting.

Otherwise, the results in Table (2) show that the total cholesterol and LDL-C decreased but not significantly during Ramadan fasting. These results were observed in the study reported by Maislos *et al.* (1993) in which plasma total cholesterol and LDL-C slightly decreased during Ramadan fasting. In the same respect, HDL-C slightly increased at the end of Ramadan fasting (Table 2). These results disagreed with the data reported by Aldouni *et al.* (1997), who observed a marked increase (14.3%) in serum HDL-C during Ramadan fasting, also, Maislos *et al.* (1993) who showed an increase by 30% of HDL-C at the end of Ramadan fasting.

Many investigators (Gwinup *et al.*, 1963; and Wolfram *et al.*, 1987) reported that nibbling diet or increase meal frequency reduced both serum total cholesterol and LDL-C, but decreased eating frequency elevated plasma cholesterol levels (Young *et al.*, 1972).

From the data in Table (2) it can be observed that Ramadan fasting improve the ratio of TC to HDL-C and LDL-C to HDL-C. These results were confirmed with the results of Maislos *et al.* (1993). They mentioned that Ramadan fasting significantly increased HDL-C and improved the ratios of TC to HDL-C and LDL-C to HDL-C.

The concentration of triglyceride was significantly ($P<0.05$) decreased at the end of Ramadan compared with the day before Ramadan fasting (Table 2). This result was confirmed with different results of some authors, who reported that triglyceride was decreased in healthy (Gumaa *et al.* 1978; El-Hazmi *et al.*, 1987; Aldouni *et al.* 1997; and Mohammadi *et al.*,2001) and in obese hypercholesterolemic subjects (Mohammadi *et al.*, 2001 and Afrasiabi *et al.*, 2003) during Ramadan fasting.

As shown in Table (2), serum uric acid had increased significantly ($P<0.05$) and the mean body weight had decreased significantly ($P<0.05$) from base line to day 28 of Ramadan. These changes were attributed to dehydration and to an excessive breakdown of RNA tissue during Ramadan (Gumaa *et al.*, 1978 and Salehi *et al.*, 2001). From a regression analysis (Nomani *et al.*, 1990) indicated a negative relationship between changes in uric acid level and change in body weight.

Concerning serum protein levels, the results in Table (2) show that Ramadan fasting significantly ($P<0.05$) decreased serum total protein. The decrease in total protein could be due to relative dehydration and energy intake restriction, which are associated with weight loss. Also, it could be attributed to a decrease rate of purine synthesis and excessive breakdown of RNA tissue, which lead to decrease protein biosynthesis. These results agreed with Khan and Muzaffar (2002) but contradict with Ramadan (1994) who found an increase of total protein after Ramadan fasting.

Table(2):Effect of Ramadan fasting on serum lipid profile, serum glucose, uric acid, total protein and body weight.

Variables	Pre-Ramadan*	End of Ramadan**
Total cholesterol (mmol/L)	5.20(±0.72)	5.16(±0.67)
HDL-cholesterol (mmol/L)	1.79(±0.23)	1.82(±0.25)
LDL-cholesterol (mmol/L)	2.96(±0.44)	2.92(±0.42)
Triglyceride (mmol/L)	1.48(±0.55)	1.20(±0.51)***
Glucose (mmol/L)	4.91(±0.50)	4.51(±0.52)***
Uric acid (mmol/L)	0.25(±0.1)	0.29(±0.2)***
Total protein (g/L)	68.2(±2.7)	67.1(±2.9)***
Body weight (kg)	85.5(±3.9)	83.2(±3.3)***

(values are mean±SD n=45) * One day before Ramadan.

28th day of Ramadan. * Significant ($P<0.05$) compared to pre-Ramadan values.

In conclusion, this study suggests striking changes in nutritional habits during Ramadan, which may be useful in reducing serum lipids and lipoproteins but not useful in reducing protein and increasing uric acid through Ramadan fasting. These changes could be beneficial for cardiovascular system and gout diseases when fasting Muslims are encouraged to use high protein, low fat and low calory diets.

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التغيرات في وزن الجسم وبعض التغيرات الكيموحيوية المرتبطة بصوم شهر رمضان فى بعض الرجال السعوديين الاصحاء

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ملخص

أخذت قياسات وزن الجسم وكمية الطاقة الكلية المتناولة في اليوم بالإضافة إلى بعض القياسات الكيموحيوية لمستويات الجلوكوز، الكولسترول الكلي، كولسترول البروتينات الشحمية منخفضة ومرتفعة الكثافة، الجلسريدات الثلاثية، البروتين الكلي وحامض اليوريك في سيرم مجموعة من٤٥ من المتطوعين الرجال السعوديين الأصحاء المسلمين قبل بداية شهر رمضان مباشرة وعند نهايته (شهر الصوم للمسلمين).

أظهرت النتائج انخفاض معنوي في وزن الجسم وكمية الطاقة الكلية المتناولة ونوعية العناصر الغذائية وذلك في نهاية شهر رمضان مقارنة بهذه القياسات قبل بداية شهر رمضان.

كان هناك انخفاض ملحوظ (مستوي معنوية ٠,٠٥) في مستويات الجلوكوز، البروتين الكلي، والجلسريدات الثلاثية في السيرم. وعلى العكس من ذلك لوحظ زيادة معنوية في مستوى حامض اليوريك في السيرم ولكن لم يكن هناك تغير معنوي في مستوى الكولسترول الكلي أو كولسترول البروتينات الشحمية منخفضة أو مرتفعة الكثافة.

ويمكن القول بأن صوم رمضان يسبب خفض الوزن عند تحديد الوجبات وتخفيض كمية الطاقة الكلية المتناولة يوميا مع حدوث تغير بسيط في بعض القياسات الكيموحيوية ولكن هذه التغيرات في حدود المدى الطبيعي لنفس القياسات قبل شهر رمضان وقد تكون تغيرات عكسية.

المجلة العلمية لكلية الزراعة – جامعة القاهرة – المجلد (٥٧)العـــدد الاول يناير(٢٠٠٦) : ٦٧-٧٨ .