Journal of Medical Sciences

ISSN 1682-4474

science alert

ANSInet
an open access publisher
http://ansinet.com

Research Paper

JMS (ISSN 1682-4474) is an International, peer-reviewed scientific journal that publishes original article in experimental & clinical medicine and related disciplines such as molecular biology, biochemistry, genetics, biophysics, bio-and medical technology. JMS is issued four times per year on paper and in electronic format.

For further information about this article or if you need reprints, please contact:

Khalid Al-Numair
Department of Food Science and Nutrition,
College of Food Science and Agriculture,
King Saud University,
P.O. Box 2460, Riyadh 11451,
Saudi Arabia

Tel: 00966-1-4678558
Fax: 00966-1-4678394

J. Med. Sci., 6 (1): 112-116
January-March 2006

Body Weight and Some Biochemical Changes Associated with Ramadan Fasting in Healthy Saudi Men

Khalid Al-Numair

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 Arabian healthy Muslim men at pre and at end of Ramadan, the Muslim month of fasting. Body weight, total daily energy intake and the qualitative compounds of nutrients were significantly decreased ($p<0.05$) at the end of Ramadan. There was a significant decrease ($p<0.05$) in the levels of serum glucose, serum total protein and serum triglyceride. In contrast, there was a significant increase ($p<0.05$) serum in uric acid. There were no significant changes in the levels of serum total cholesterol and high and low density of lipoprotein cholesterol. It was concluded that Ramadan fasting could induce weight loss through restriction diet and energy intake with consequent little changes in biochemical parameters. These changes were within normal reference range of pre Ramadan values and appear to be reversible.

Key words: Fasting, energy intake, lipid profile

ANSInet
Asian Network for Scientific Information

Department of Food Sciences and Nutrition,
College of Food Sciences and Agriculture,
King Saud University, Saudi Arabia

INTRODUCTION

Ramadan, one of the five pillars of Islam, it is the 9th 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[1].

Despite the importance and worldwide nature of this religious practice, only a few studies of metabolic implications of Ramadan fasting have been published[2-7]. Different results have been reported on the effect of Ramadan fasting on changes in body weight[2,3,7] and body mass index (BMI)[2,6] as well as serum total cholesterol (TC), triglyceride (TG), low density lipoprotein-cholesterol (LDL-C), and high density lipoprotein-cholesterol (HDL-C)[6-8]. Gumaa *et al.*[4] reported that serum uric acid concentration increased with the days of fasting, also, serum protein concentration increased with Ramadan fasting[9], in contrast blood glucose decreased[8,10].

The 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.

MATERIALS AND METHODS

The study was conducted on forty five volunteer healthy men (30-45 years old) in Ramadan month during the year 2004, in Buraidah, one of the main cities of Qassim region, Saudi Arabia. The study started one week before Ramadan month 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 model was used to help them estimate the serving size for daily food intake. Daily food intake for three non consecutive days (2 week days and one week end day) one week before Ramadan month (Pre-Ramadan) and other three in the fourth week of Ramadan month (End-Ramadan) were recorder 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 meal.

Body weight and blood samples of the participants were taken one day before Ramadan month and in the day of 28th on the month. Trained staff collected blood samples and measured the body weight of the volunteers. Weight was measured to the nearest 100 g with subject in light clothes and without shoes. The weighing scale used was Health 0 m 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 h fasting (after shahor, the meal before dawn) and before Ramadan month blood samples were collected after 10-12 h 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 is 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[11].

Cholesterol is determined enzymatically using cholesterol esterase and cholesterol oxidase. Cholesterol is 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[12].

HDL-C in serum was assayed directly by automated method using polyethylene glycol-modified enzyme and dextrain sulfate[13].

LDL-C in human serum was assayed directly by homogenous enzymatic assay[14].

Triglyceride was determined by enzymatic colorimetric test according to the method of Stein and Myers[15].

Total serum protein was assayed using buiret reagent. The colour intensity is directly proportional to the protein concentration, which can be determined photometrically[16].

Uric acid was determined after oxidized to allenatoine and hydrogen peroxide in the presence of 4-amino pheazone dye to give red colour which proportionally to the concentration of uric acid[17].

Data analysis: Analysis of data was performed using Statistical Package for the Social Sciences (SPSS), version 11.0 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 month. Differences were considered significant at $p<0.05$.

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 reduced ($p<0.05$) 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 derived from carbohydrates, protein and fats were significantly reduced ($p<0.05$) by 11.4, 14.2 and 7.8%, respectively at the end of Ramadan compared with the pre-Ramadan values.

When the results were compared with the pre-Ramadan values, there was a significant decrease ($p<0.05$) in body weight: 85.5±3.9 kg at pre-Ramadan and 83.2±3.3 kg at the end of Ramadan (Table 2).

Plasma lipoprotein analysis (pre-Ramadan Vs end of Ramadan, respectively) revealed that TC (5.2±0.72 and 5.16±0.67 mM L^{-1}), LDL-C (2.96±0.44 and 2.92±0.42 mM L^{-1}) and HDL-C (1.79±0.25 and 1.82±0.25 mM L^{-1}) did not changes significantly.

Serum TG concentrations were significantly ($p<0.05$) reduced at the end of Ramadan (1.2±0.51 mM L^{-1}) than at pre-Ramadan (1.98±0.55 mM L^{-1}) and also, serum glucose and total proteins were significantly ($p<0.05$) decreased to 4.51±0.5 mM L^{-1} and 68.2±2.7 g L^{-1}, respectively, at the end of Ramadan compared with 4.91±0.52 and 67.1±2.9 g L^{-1} respectively at pre-Ramadan.

In contrast serum uric acid concentration was significantly ($p<0.05$) increased to 0.29±0.2 mM L^{-1} at the end Ramadan compared with 0.25±0.1 mM L^{-1} at pre-Ramadan.

The calculated (pre-Ramadan Vs end 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.

DISCUSSION

Since the metabolic consequences of fasting during Ramadan are not a clearly known, present study investigated 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 decrease the intake of carbohydrates (40.0±2.3 g), proteins (10.0±0.8 g) and fats (4.0±0.28 g) by 11.4, 14.2 and 7.8%, respectively, compared with pre-Ramadan. Present findings were agree with Chandelia *et al.*[18] they showing a decrease of daily energy intake in Indian Moslems during Ramadan fasting. Also, Khan and Muzaffar[19], mentioned that the average daily energy intake was reduced by 857±41 kcal in the month of fasting.

However, present results contradict those showing an increase of total energy intake in Saudi subjects during Ramadan fasting[3] and also, those reported in Tunisian subjects which showed no change in the total daily energy intake[20].

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[5,21,22] 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 decrease ($p<0.05$) 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[23] who induce 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[19] 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 cause a significant reduction in caloric intake estimated by 857±410 kcal day^{-1} and lost 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 decrease in fluid intake[4,24].

In this study serum glucose was significantly ($p<0.05$) decreased during Ramadan fasting (4.51±0.52 mM L^{-1}) in comparison to the control day

Table 1: Effect of Ramadan month fasting on energy, carbohydrate, protein and fat intakes

Variables	Pre-Ramadan*	Pre-Ramadan**	Reduction values	Reduction (%)
Energy (kcal)	2150.0±133.0	1910.0±90.0***	240.0±43.0	11.2
Carbohydrate (g)	350.0±024.0	310.0±12.0***	40.0±2.30	11.4
Protein (g)	70.0±004.0	60.0±04.2***	10.0±0.80	14.2
Fat (g)	55.0±004.6	51.0±03.1***	4.0±0.28	7.8

(Values are Mean±SD n=45), * Average of three days one week before Ramadan month non consecutive, ** Average of three non consecutive days in fourth week of Ramadan, *** Significant ($p<0.05$) compare to Pre-Ramadan values

Table 2: Effect of Ramadan month fasting on body weight and biochemical parameters

Variables	Pre-Ramadan*	End-Ramadan**
Total cholesterol (mM L^{-1})	5.20±0.72	5.16±0.67
HDL-cholesterol (mM L^{-1})	1.79±0.23	1.82±0.25
LDL-cholesterol (mM L^{-1})	2.96±0.44	2.92±0.42
Triglyceride (mM L^{-1})	1.48±0.55	1.20±0.51***
Glucose (mM L^{-1})	4.91±0.50	4.51±0.52***
Uric acid (mM L^{-1})	0.25±0.1	0.29±0.2***
Total protein (g L^{-1})	68.20±2.7	67.10±2.9***
Body weight (kg)	85.50±3.9	83.20±3.3***

(Values are Mean±SD n=45), * One day before Ramadan month, ** 28th days of Ramadan month, *** Significant ($P<0.05$) compare to Pre-Ramadan values

before Ramadan fasting (4.91±0.50 mM L^{-1}), these results may be due to energy intake restriction induced by fasting. However, several studies[25-27] have demonstrated that fasting glucose did not change during Ramadan fasting.

Otherwise, the results in Table 2 showed that total cholesterol and LDL-C decreased but not significantly during Ramadan fasting. These results were observed in the study reported by Maislos *et al.*[6] 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 are disagreement with data reported by Adlouni *et al.*[28], they observed a marked increase (14.3%) in serum HDL-C during Ramadan fasting, also, Chong *et al.*[26] showing an increase by 30% of HDL-C at the end of Ramadan fasting.

Many investigators[29-31] reported that nibbling diet or increase meal frequency reduced both serum total cholesterol and LDL-C, but decreased eating frequency elevate plasma cholesterol levels[32].

From the data in Table 2 it was shown 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.*[6]. 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 decreased ($p<0.05$) at the end of Ramadan compared with the day before Ramadan fasting (Table 2). This result was confirmed with different results of some authors. They reported that triglyceride was decreased in healthy[4,28,33,34] and in obese hypercholesterolemic subjects[7,34] during Ramadan fasting. Serum uric acid had increased significantly ($p<0.05$) and the mean body weight had decreased significantly ($p<0.05$) from base line to 28th day of Ramadan (Table 2). These changes were attributed to dehydration and to an excessive breakdown of RNA tissue during Ramadan[4, 35]. From a regression analysis[36] indicating a negative relationship between changes in uric acid level and change in body weight.

Concerning serum protein levels, Ramadan fasting significantly decreased ($p<0.05$) serum total protein(Table 2). The decrease in total protein could be due to relative dehydration and energy intake restriction which 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 were agree with Khan and Muzaffar[19] but contradict with Ramadan[9] who found an increase of total protein after Ramadan fasting.

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 calories diets.

REFERENCES

1. Sakr, A.H., 1975. Fasting in Islam. J. Am. Diet. Assoc., 67: 17-20.
2. Fedail, S.S., P. Murphy, Y.S. Slih, H.C. Bolton and F.R. Harvey, 1982. Changes in certain blood constituents during Ramadan. Am. J. Clin. Nutr., 38: 350-353.
3. Frost, G. and S. Pirani, 1987. Meal frequency and nutritional intakes during Ramadan: A pilot study. J. Nutr. Applied Nutr., 41: 47-50.
4. Gumaa, K.A., K.Y. Hustafa, N.A. Mahmoud and A.M. Gaber, 1978. The effect of fasting in Ramadan on serum uric acid and lipid concentration. Br. J. Nutr., 40: 573-581.
5. Husain, R., M.T. Duncan, S.H. Cheah and S.L. Ching, 1987. Effect of fasting in Ramadan on tropical Muslims. Br. J. Nutr., 58: 41-48.
6. Maislos, M., N. Khamaysi, A. Assali, Y. Abou-Rablab, I. Zvili and S. Shany, 1993. Marked increase in plasma high-density-lipoprotein cholesterol after prolonged fasting during Ramadan. Am. J. Clin. Nutr., 57: 640-642.

7. Afrasiabi, A., S. Hassanzadeh, R. Satharivand, M. Nouri and S. Mahbood, 2003. Effects of low fat and low calories diet on plasma lipid levels in the fasting month of Ramadan. Saudi Med. J., 24: 184-188.
8. Bilto, Y.Y., 1998. Effects of Ramadan fasting on body weight and the biochemical and haematological parameters of the blood. Arab Gulf J. Sci. Res., 16: 1-13.
9. Ramadan, J., 1994. Effect of Ramadan fasting on physical performance, blood and body composition. In: Proceeding of 1st International Congress Ramadan Health, Casablanca, pp: 99-107.
10. Roky, R., I. Houti, S. Moussamih, S. Qotbi and N. Adil, 2004. Physiological chronobiological changes during Ramadan intermittent fasting. Ann. Nutr. Metab., 48: 296-303.
11. Kaplan, L.A., 1987. Glucose. In: Methods in Clinical Chemistry, Kaplan, L.A. and A.J. Pesce. (Eds.), Mosby Company, pp: 105-112.
12. Naito, H.K., 1987. Cholesterol. In: Methods in Clinical Chemistry, Kaplan, L.A. and A.J. Pesce. (Eds.), Mosby Company, pp: 1156-1178.
13. Sugluchi, H., Y. Hji, H. Okabe and T. Irie, 1995. Direct measurement of high-density lipoprotein cholesterol in serum with polyethylene glycol-modified enzymes and sulfated α-cyclodextrin. Clin. Chem., 41: 717-725.
14. Bachoric, P., 2000. Measurement of low Density-lipoproprotein. In: Handbook of lipoprotein testing, Roifai, W. and D. Dominiczak (Eds.), AACC Press, pp: 245-263.
15. Stein, E.A. and G.L. Myers, 1995. National cholesterol education program recommendations for triglycerides measurements: executive summary. Clin. Chem., 41: 1421-1426.
16. Koller, A., 1987. Total Serum Protein. In: Methods in Clinical Chemistry, Kaplan, L.A. and A.J. Pesce (Eds.). Mosby Company, pp: 1316-1319.
17. Kageyma, N.A., 1971. A direct Calorimetric determination of uric acid in serum and urine. Clin. Chem. Acta, 31: 421-426.
18. Chandalia, H.B., A. Bhargau and V. Kataria, 1987. Dietary pattern during Ramadan fasting and its effects on the metabolic control of diabetes. Prac. Diabetes, 4: 287-289.
19. Khan, A. and M. Muzaffar, 2002. Islamic fasting: An effective strategy for prevention and control obesity. Pak. J. Nutr., 1: 185-187.
20. El-Ati, J., C. Beji and J. Danguir, 1995. Increased fat oxidation during Ramadan fasting in healthy women: An adaptative mechanism for body maintenance. Am. J. Clin. Nutr., 62: 302-307.
21. Soliman, N.A and F.A. Khatib, 1988. Effect of Ramadan fasting on body weight and some blood constituents of healthy Muslims. Nutr. Rep. Intl., 38: 1299-1300.
22. Takruri, H.R., 1989. Effect of Ramadan fasting on body weight. Saudi Med. J., 10: 491-494.
23. Nicholls, A. and J.T. Scott, 1972. Effect of weight loss on plasma urinary levels of uric acid. Lancet, 2: 12-23.
24. Sweileh, N., A. Scnitzler, G.R. Hunter and B. Daris, 1992. Body composition and energy metabolism in resting and exercising Muslims during Ramadan fasting. J. Sport Med. Phys Fitness, 32: 156-163.
25. El-Arnoaty, Y.M. and W.A. Johnson, 1991. Nutritional and biochemical changes during Ramadan fasting. FASEB. J., 5: 1665.
26. Chong, S.L., S.H. Cheah, R. Husain and M.T. Duncan, 1993. Endocrine changes in Aslatic Moslems during Ramadan. Clin. Biochem. Rev., 14: 247.
27. Maislos, M., Y. Abou-Rabiah, I. Zuili, S. Iordash and S. Shany, 1998. Gorging and plasma HDL cholesterol: The Ramadan model. Eur. J. Clin. Nutr., 52: 127-130.
28. Aldouni, A., N. Ghalim, A. Benslimane, J.M. Lecerf and R. Saile, 1997. Fasting during Ramadan induces a marked increase in high-density-lipoprotein cholesterol and decrease in low-density-lipoprotein cholesterol. Ann. Nutr. Metab., 41: 242-249.
29. Gwinup, G., R.C. Byron, W.H. Roush, P.A. Kruger and G.J. Hamwi, 1963. Effect of nibbling versus gorging on serum lipid in man. Am. J. Clin. Nutr., 13: 209-213.
30. Wolfram, H., M. Kirchgessner, H.L. Muller and S. Hollomey, 1987. Thermogensis in humans after varying meal time frequency. Ann. Nutr. Metab., 31: 88-97.
31. Jenkins, D.J., T.M. Wolever and V. Vuksan, 1989. Nibbling versus gorging: Metabolic advantages of increase meal frequency. N. Eng. J. Med., 321: 929-934.
32. Young, C.M., L.F. Hunter, S.S. Scanlan, G.E.R and, L. Lutwak and V. Simko, 1972. Metabolic effects of meal frequency on normal young men. J. Am. Diet. Assoc., 61: 391-396.
33. El-Hazmi, M.A., F.Z. Al-Faleh and I.A. Al-Mofleh, 1987. Effect of Ramadan fasting on the value of hoematological and biochemical parameters. Saudi Med. J., 8: 171-176.
34. Mohammadi, N.F., P. Mirmiran, M. Rahmani, B. Siahkolah and F. Aziz, 2001. Body Mass Index and Lipid Profile in Tehranian Man after Islamic Fasting. Iranian J. Endocrinol. Metab., Book Cong. Ramadan Health, Iran, pp: 2.
35. Salehi, P., F. Valaie, M.R. Mirbolooki and H. Emami, 2001. The Effect of Ramadan Fasting on Serum Uric Acid Concentration Electrolytes and Body Weight. Iranian J. Endocrinol. Metab., Book Cong. Ramadan Health, Iran, pp: 4.
36. Nomani, M.Z., M.H. Hallak and F.P. Siddiqui, 1990. Effect of Ramadan fasting on plasma uric acid and body weight in health man. J. Am. Diet. Assoc., 10: 1435-1436.