

Effects of Ramadan Fasting on Some Biochemical Parameters in healthy subjects.

Haleema AINahari¹ and Hamed Kouja²

Abstract—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. Modifications in the circadian distribution of the eating and sleeping schedule result in various changes in different biochemical parameters. In this study the effect of fasting on glucose, insulin, Cortisol, triglyceride, cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL), estradiol, testosterone, thyroid stimulating hormone (TSH), FT4 and FT3 during and post fasting was measured. Blood samples were taken from 26 adult male subjects during and post fasting. The results obtained showed a significant decrease in glucose and TSH levels, while the levels of insulin triglyceride, free thyroxine (FT4) and free triiodothyronine (FT3) showed a significant increase. This study showed that there are changes in dietary habits depending on cultural rituals, often practices during Ramadan, among Muslim societies. Consequently that may affect various components of metabolic importance.

Keywords: Ramadan Fasting, biochemical parameters, Glucose, Insulin, Cortisol, Cholesterol, Testosterone, lipoprotein and thyroid stimulating hormone..

1. INTRODUCTION

Ramadan is month during which Muslims refrain from food liquid hours and eat a m Free eating is allowed from sunset to dawn. Ramadan teaches Muslims self-restraint and reminds 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 biochemical changes over Ramadan time (Al Hourani, 2009).

Ramadan fasting affects a huge population, numerous studies were performed in the last two decades to show the effect of Ramadan fasting on various parameters in healthy (Dewanti et al., 2006; Ziaee et al., 2006) and unhealthy populations (Sadiya et al., 2011; Khafaji et al., 2012; Kul et al., 2013).

The metabolic effects of fasting during Ramadan, may be affected by genetic and environmental factors, such as nutrition habits and the length of fasting day. Therefore, differences in the effects of Ramadan fasting may occur between seasons and countries (Azizi, 2010).

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 meal frequency reduction on biological indices (Al Hourani, 2009).

In most of the studies, it was found that Ramadan fasting leads to changes in the metabolic status including blood glucose and lipid (Dewanti et al., 2006; Ziaee et al., 2006; Sadiya et al., 2011; Khafaji et al., 2012; Kul et al., 2013). However, results of these studies vary due to eating habits, gender, age, and ethnicity.

Metabolic modifications are accompanied by endocrine changes thought to be capable of altering sleep. Compared with non-fasting controls, cortisol secretion is significantly higher during Ramadan (Sliman et al., 1993).

All recent studies on healthy subjects with normal body weight to show the effect of Ramadan fasting on the most widely reported health outcomes including total cholesterol, HDL (high density lipoprotein), LDL (low density lipoprotein), triglycerides, and fasting blood glucose (Kul et al., 2013).

Fasting in Ramadan has been shown to have some effects on the circulating levels of several biochemical markers known to be associated with vascular and metabolic disorders including lipid profile (Zadegan et al., 2000; Saleh et al., 2005; Khaled and Belbraouet.,

¹Department of Biological Sciences, Faculty of Science, King Abdul Aziz University .

²Department of Medical Technology Sciences, King Abdul Aziz University.

2009). It is known that the lipid is influenced by dietary habits, physical factors, the percentage of fat, type of fat saturation, and the percentage of simple sugars in the daily diet and weight loss (Hallak and Nomani, 1988; Nomani et al., 1992; Maislos et al., 1993; Adlouni et al., 1997; Nomani, 1997; Nagra et al., 1998; Tsai et al., 2003; Furuncuoglu et al., 2007). Ramadan fasting showed to have effect on lipid profile by increasing HDL and decreasing LDL levels (Mansi, 2007; Ibrahim, et al., 2008; Lamri-Senhadji, et al., 2009). It has been found a significant decrease in serum cholesterol and serum triglycerides (Marbut et al.2005) . It has been reported that a significant increase in high density lipoprotein - cholesterol (HDL-C) and a decrease in low density lipoprotein - cholesterol (LDL-C) during Ramadan (Marbut et al.2005; Abdulrahman et al 2006 and Farshidfar et al., 2006). Moreover, there are regional disparities in dietary habits depending on cultural rituals, often practices during Ramadan, among Muslim societies. Consequently such disparities may affect various components of metabolic importance (Barkia et al., 2011). Other lifestyle changes, most notably, the more frequent and voluntary prayers performed during Ramadan which is comparable to moderate exercise, may lead to a healthier outcome (Shehab et al., 2012). Several studies have demonstrated the effect of total food abstinence on the peripheral metabolism of thyroid hormone and hypothalamic-pituitary-thyroid axis (Boear et al., 1983; Spencer et al., 1983). Fedail et al. (1982) has studied serum levels of thyroid hormones on the first and the last days of Ramadan and found significant increase in serum T4 but no change in serum T3 levels. Khan et al. (1986) in their study on 33 normal volunteers compared serum T3 and T4 levels during 15th hour of fasting with levels reached three hours after breaking the fast. They did not observe any significant difference. Al-Chalabi ,(2013) Resulted that was a decrease in testosterone level after fasting but not reach significance when compared with its level before fasting. Serum levels of FSH, LH, prolactin and testosterone were unchanged after fasting of Ramadan.

Aim of research:

The aim of this study was to assess the effects of Ramadan fasting on several biochemical parameters in physically active men by comparing the values of these parameters during and post fasting.

2. MATERIALS AND METHODS:

Blood samples were taken from 26 adult male subjects during and post fasting. Insulin and cortisol were measured by electrochemiluminescence immunoassay using the Elecsys 2010. Glucose, triglycer-

ide, cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL), estradiol, testosterone, thyroid stimulating hormone (TSH), FT4 and FT3 were measured using Hitachi/Roche 917 chemistry autoanalyzer.

STATISTICAL ANALYSIS:

The data were presented as the mean \pm S.E. Statistical differences between the values during and post fasting were determined by Student's t.test.

3. RESULTS AND DISCUSSION:

From table (1) and figure (1,11) the glucose (mmol/l) and TSH (mlu/l) during fasting shows a values of (5.57 ± 0.07) (3.49 ± 0.31) , and post fasting glucose and TSH shows a lower values (5.23 ± 0.15) (2.37 ± 0.20) . Glucose and TSH are significantly decreased. Insulin (μ U/l), triglyceride (mmol/l) FT4 and FT3 (pmol/l) during fasting have a values of (9.53 ± 0.73) , (1.12 ± 0.08) , (16.55 ± 0.37) , (4.52 ± 0.14) , respectively, and post fasting insulin, cortisol, triglyceride FT4 and FT3 have a higher value (28.79 ± 5.78) , (1.37 ± 0.08) (17.71 ± 0.50) (4.90 ± 0.16) , respectively, as shown in table (1) and figure (2,4, 12,13). Insulin, cortisol, triglyceride FT4 and FT3 are significantly increased post fasting. The result record that the cortisol (nmol/l), Cholesterol and HDL (nmol/l) during fasting shows a value of (267.06 ± 14.82) , (4.49 ± 0.17) (1.10 ± 0.04) , respectively, and post fasting cortisol shows a slightly higher value (296.62 ± 13.58) , (4.55 ± 0.17) (1.12 ± 0.03) , respectively, figure (3,5,6). Table (1) and figure (7) shows the levels of LDL (mmol/l), during fasting it has a value of (2.87 ± 0.14) , and post fasting LDL it has no difference in value (2.87 ± 0.15) . Estradiol (pmol/l) and testosterone levels during fasting have a value of (203.24 ± 18.23) (9.88 ± 0.80) , respectively, and post fasting estradiol and testosterone have a slightly lower value (198.43 ± 18.53) (9.38 ± 0.80) , respectively, as can be seen from table (1) and figure (9,10).

From table (1) and figure (1,11) the glucose (mmol/l) and TSH (mlu/l) during fasting shows a values of (5.57 ± 0.07) (3.49 ± 0.31) , and post fasting glucose and TSH shows a lower values (5.23 ± 0.15) (2.37 ± 0.20) . Glucose and TSH are significantly decreased. Insulin (μ U/l), triglyceride (mmol/l) FT4 and FT3 (pmol/l) during fasting have a values of (9.53 ± 0.73) , (1.12 ± 0.08) , (16.55 ± 0.37) , (4.52 ± 0.14) , respectively, and post fasting insulin, cortisol, triglyceride FT4 and FT3 have a higher value (28.79 ± 5.78) , (1.37 ± 0.08) (17.71 ± 0.50) $(4.90 \pm$

0.16), respectively, as shown in table (1) and figure (2,4, 12,13). Insulin, cortisol, triglyceride FT4 and FT3 are significantly increased post fasting. The result record that the cortisol (nmol/l), Cholesterol and HDL (nmol/l) during fasting shows a value of (267.06 ± 14.82), (4.49 ± 0.17) (1.10 ± 0.04), respectively, and post fasting cortisol shows a slightly higher value (296.62 ± 13.58), (4.55 ± 0.17) (1.12 ± 0.03), respectively, figure (3,5,6). Table (1) and figure (7) shows the levels of LDL (mmol/l), during fasting it has a value of (2.87 ± 0.14), and post fasting LDL it has no difference in value (2.87 ± 0.15). Estradiol (pmol/l) and testoste (9.88 ± 0.80), respectively, and post fasting estradiol and testosterone have a slightly lower value (198.43 ± 18.53) (9.38 ± 0.80), respectively, as can be seen from table (1) and figure (9, 10).

Ramadan is the holiest month in the Islamic . This cohort study was performed during and after Ramadan. In this study we found the level of glucose has decreased post fasting in comparison with the value during fasting. This finding was in line with the previous studies of Azizi, (1996); Sariri. et al., (2010); Kul et al., (2013) that found that a slight decrease in serum glucose occurs in normal adults after fasting has begun. In the case of blood glucose, reduction during Ramadan could be due to gluconeogenesis (Sariri. et al., 2010).

Table 1. Mean values of Glucose, Insulin, Cortisol, Triglyceride, Cholesterol, HDL, LDL, HDL/LDL ratio, Estradiol, Testosterone, TSH, FT4 and FT3 during and post fasting.

	Fast Mean ± S.E	Post Mean ± S.E
Glucose (mmol/l)	5.57 ± 0.07	5.23 ± 0.15*
Insulin (μU/l)	9.53 ± 0.73	28.79 ± 5.78*
Cortisol (nmol/l)	267.06 ± 14.82	296.62 ± 13.58
Triglyceride (mmol/l)	1.12 ± 0.08	1.37 ± 0.08*
Cholesterol (mmol/l)	4.49 ± 0.17	4.55 ± 0.17
HDL (mmol/l)	1.10 ± 0.04	1.12 ± 0.03
LDL (mmol/l)	2.87 ± 0.14	2.87 ± 0.15
HDL/LDL ratio	0.41 ± 0.03	0.42 ± 0.03
Estradiol (pmol/l)	203.24 ± 18.23	198.43 ± 18.53
Testosterone (nmol/l)	9.88 ± 0.80	9.38 ± 0.80
TSH (mlu/l)	3.49 ± 0.31	2.37 ± 0.20*
FT ₄ (pmol/l)	16.55 ± 0.37	17.71 ± 0.50*
FT ₃ (pmol/l)	4.48 ± 0.13	4.94 ± 0.15*

The mean ± S.E. P < 0.05*.

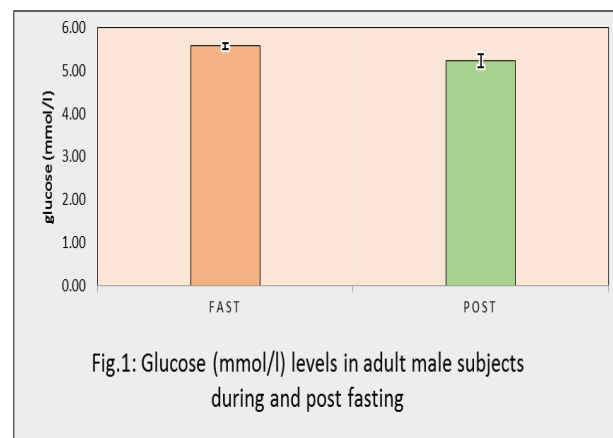


Fig.1: Glucose (mmol/l) levels in adult male subjects during and post fasting

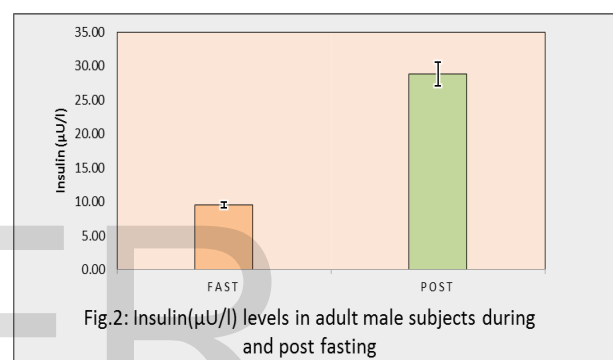


Fig.2: Insulin(μU/l) levels in adult male subjects during and post fasting

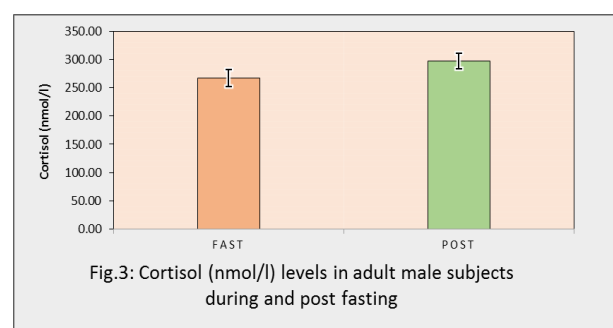


Fig.3: Cortisol (nmol/l) levels in adult male subjects during and post fasting

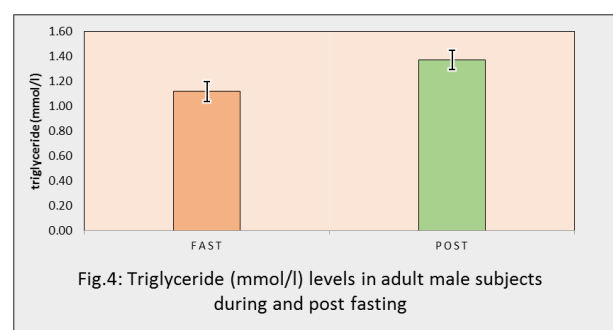
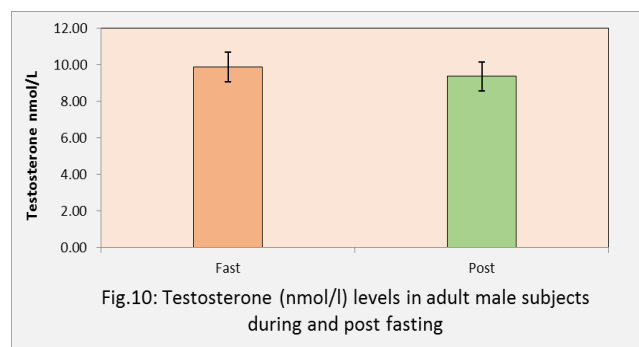
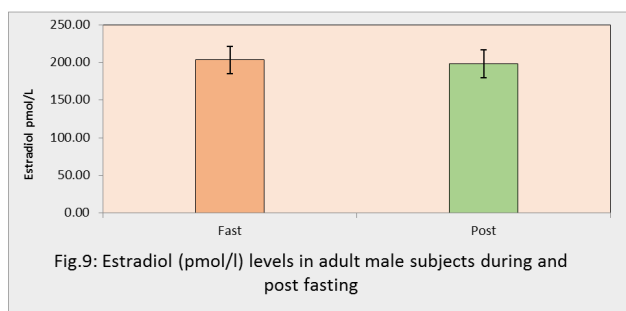
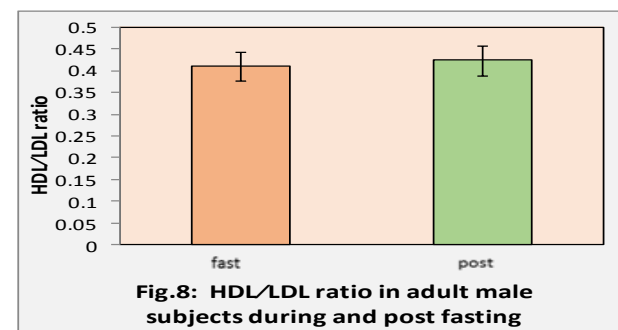
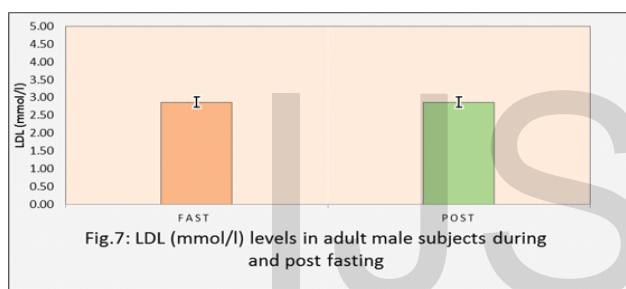
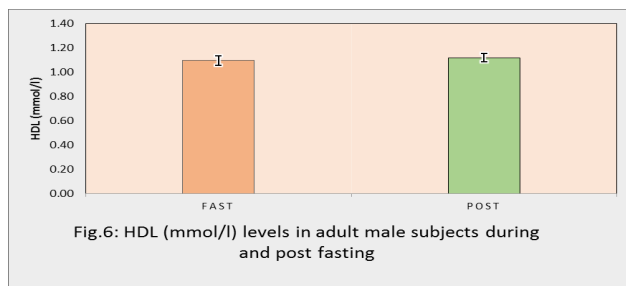
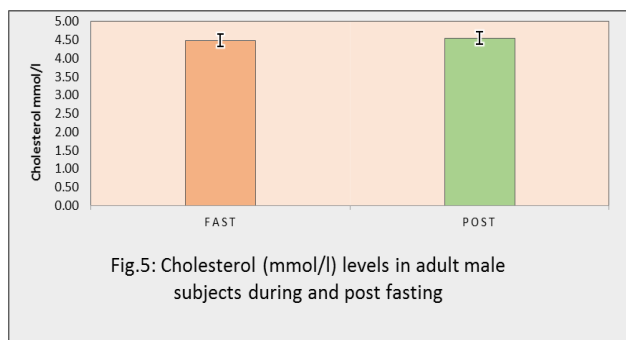


Fig.4: Triglyceride (mmol/l) levels in adult male subjects during and post fasting



However, the results recorded an increase in insulin and cortisol levels in fasting comparison with the value post fasting, the increase in insulin may be due to maintain glucose levels in the normal range which agrees with the study of Hasselbalch et al. (1995). They found that the elevations of insulin were to be able to maintain glucose levels in the normal range (Bahijri et al. 2013). The increase in cortisol levels during Ramadan, may be due to the greatly disturbed sleeping pattern the results are in agreement with earlier studies of al-Hadramy et al. (1988); Ben Salem et al. (2002); Haouari et al. (2008) that reported higher cortisol during the month of Ramadan. The elevation of cortisol post fasting was caused by a greatly disturbed sleeping pattern and may be associated with the hypercortisolism of chronic stress (Bahijri et al. 2013).

Also the current study found a significant decrease in triglyceride level in fasting comparison with the value post fasting. That may be due to that Ramadan may have beneficial influence on metabolic.

The reports of Haghdoost and Poorranjbar (2009); Mahboob et al. (1999); Asgary et al. (2000); Marbut et al.(2005); Unalacak et al.(2011) and Al-Shafei (2013) agree with our findings as they found a significant decrease in serum triglyceride during Ramadan. The reduction in serum triglyceride can be explained either by changes in fat intake or inherent metabolic changes during Ramadan (Mahboob et al. 1999 and Asgary et al. 2000). Fasting improves lipids profile (Unalacak et al. 2011 and Al-Shafei 2013)

Haghdoost and Poorranjbar (2009) They found that physical activity alone cannot explain the variations in the lipid profile. Other factors, such as changes in the diet and sleeping hours, may have more important roles

While, an increase in cholesterol levels was found in this study. These results are in agreement with

the reports of Gumaa et al., (1978) ;El-Hazmi et al., (1987) and Ziaee et al. (2006) They said that serum cholesterol may rise during Ramadan. That elevation may be related to weight loss during Ramadan fasting (Fedail et al., 1982; Shoukry, 1986; Hallak and Nomani, 1988; Ziaee et al., 2006).

And, there was an increase in HDL after fasting in the present study, which agrees with the previous studies of Adlouni et al. (1997); Maislos et al. (1998); Rahman et al. (2004); Farshidfar et al. (2006); Salehi and Neghab, (2007); Chaouachi et al. (2008); Kul et al. (2013) that found a marked increase in plasma HDL occurring after Ramadan fasting has been observed. The changes in lipid profile, however, may vary depending on the quality and quantity of food intake, and physical activity (Alkandari et al. 2012). But, this study we found no change in the level of LDL after fasting, and that agrees with the study of Bahijri et al. (2013) that found that LDL had a remarkable stability that can be explained by the feeding pattern of the subjects.

While, there has been a decrease in the ratio of LDL/HDL, and that agrees with the previous studies of Streja et al. (1980); Maislos et al. (1993); Murphy et al. (1996), and that may be due to eating one large meal each day and that leads to a significant increase in serum HDL levels, while decreasing the LDL/HDL ratio in healthy subjects during Ramadan (Streja et al. 1980; Maislos et al. 1993 and Murphy et al. 1996).

It has been found in this study that estradiol level decreased slightly and insignificantly, that comes in line with Shahabi, (2010) that found that Islamic fasting causes neither significant variation in the secretion of hormones around ovulation nor does it influence the occurrence of ovulation.

Also, the current study found a decrease in the level of testosterone. Mean testosterone levels decreased in the study of Mesbahzadeh et al. (2005), which agrees with our findings. Other studies found no significant change in the levels of testosterone before, during and after Ramadan (Azizi, 1991, El-Migdadi et al. 2004). Previous studies have demonstrated that abstinence from eating and drinking during the Ramadan fast, which is accompanied by variations in the sleeping and waking pattern, and the psychological effects of fasting may bring about rhythmic changes in the secretion of most of the body's hormones (Fedail et al. 1982; Irak et al. 1997).

In our study we found a significant increase in TSH level during Ramadan fasting, this result agree

with the study of Sajid et al. (1991) and Bogdan et al. (2001) that said that normal adults basal levels of TSH decreased by 50% after 36 hours of fasting. The increase in TSH level might be due to daytime fasting, modifications in sleep schedule and psychological and social habits during Ramadan that induce changes in the rhythmic pattern of a number of hormonal variables (Bogdan et al. 2001).

Consequently, this study reported a significant decrease in FT3 and FT4, during Ramadan fasting might be due to feeding behavior. that does not agree with previous study of Azizi, (1991) that reported that Ramadan has no effect FT3 level. This study agree with Chaouachi et al. (2008) they found change in FT3 might be duo to metabolic adjustments made with alterations in fluid and food intake and bdulla,(2011) They resulted that there were reduction in diameter of thyroid follicles, amount of colloid and height of follicular epithelium in the experimental group. There was a significant increase in the number of C- cells in experimental group. The reduction in thyroid follicles, thyroid colloid and height of follicular epithelium occur as a result of changing in feeding behavior which causes decrease in iodine food incorporation, and decrease in level of 5- monodeiodinase a mediator of T3 and T4. The increase in the number of C cells happened as a protective mechanism to save the skeleton from excessive bone resorption. Belchetz et al. (1978)The decrease in TSH level and increase in FT4 and FT3 is a natural result of the negative feedback regulation of thyrotrophin secretion .

References

- [1]J. Abdulla ,A. G.(2011) .Histological Effects of fasting and subsequent refeeding on thyroid follicles of rabbits morphometric analysis .Medical Journal of Tikrit ;2: 12-16.
- [2]. Abdulrahman, M. A. Manssor, A. J. and Marbut, M. M. (2006). The effect of Ramadan fasting & Moderate exercise on body weight, serum glucose & lipid profile in healthy fasting subjects. Medical Journal of Tikrit ;2: 26-30.
- [3] Alkandari, J.R., Maughan, R.J., Roky, R., Aziz, A.R.and Karli, U. (2012) The implications of Ramadan fasting for human health and well-being. J Sports Sci, 1: 9-19.
- [4] -Chalabi ,S.(2013) . Effect of Ramadan Fasting on Sex Hormones in Infertile Male.Medical Journal of Tikrit: ;9: 277-281.
- [5] Al-Hadramy, MS., Zawawi, T.H.and Abdel-

- wahab, S.M. (1988) Altered cortisol levels in relation to Ramadan. *Eur J Clin Nutr*, 42: 359-362.
- [6] Al Hourani, H.M., Atoum, M.F., Akel, S., Hijjawi, N., Awawdeh, S. (2009) Effects of Ramadan Fasting on Some Haematological and Biochemical Parameters. *Jordan Journal of Biological Sciences*, (2)3:103- 108.
- [7] Al-Shafei, A.I.(2013). Ramadan fasting ameliorates arterial pulse pressure and lipid profile, and alleviates oxidative stress in hypertensive patients. *Blood Press*. 23.
- [8] Asgary, S., Aghaei, F., Naderi, G.A., Kelishadi, R., Gharipour, M. and Azali, S. (2000) Effects of Ramadan fasting on lipids peroxidation, serum lipoproteins and fasting blood sugar. *Medical Journal of Islamic Academy of Sciences*, 13: 9-35.
- [9] zizi, F., (2010) Islamic Fasting and Health. *Ann Nutr Metab*, 56: 273-282.
- [10] Azizi, F. (1996) Medical aspects of Islamic fasting. *Iranian Journal of Medical Sciences*, 10(1): 241-246.
- [11] Azizi, F. (1991) Serum levels of prolactin, thyrotropin, thyroid hormones, TRH responsiveness, and male reproductive function in intermittent Islamic fasting. *Medical Journal of the Islamic Republic of Iran*, 5(3): 145-148.
- [12] Bahijri, S., Borai, A., Ajabnoor, G., Abdul Khamliq, A., AlQassas, I., et al. (2013) Relative Metabolic Stability, but Disrupted Circadian Cortisol Secretion during the Fasting Month of Ramadan. *PLoS ONE*, 8(4).
- [13] Barkia, A., Mohamed, K., Smaoui, M., Zouari, N., Hammami, M., et al. (2011) Change of diet, plasma lipids, lipoproteins, and fatty acids during Ramadan: a controversial association of the considered Ramadan model with atherosclerosis risk. *J Health Popul Nutr*, 29(5): 486-93.
- [14] Belchetz, P.E., Gredley, G., Bird, D. and Himsworth, R.L.(1987) Regulation of thyrotrophin secretion by negative feedback of triiodothyronine on the hypothalamus. [EndocrinolHYLINK"http://www.ncbi.nlm.nih.gov/pubmed/416161"](http://www.ncbi.nlm.nih.gov/pubmed/416161), 76(3): 48-439.
- [15] Ben Salem, L., B'Chir, S., Bchir, F., Bouguerra, R., Ben Slama, C. (2002) Circadian rhythm of cortisol and its responsiveness to ACTH during Ramadan. *Ann Endocrinol (Paris)*, 63: 497-501.
- [16] Bogdan, A., Bouchareb, B. and Touitou, Y. (2001) Ramadan fasting alters endocrine and neuroendocrine circadian patterns. Meal-time as a synchronizer in humans? *Life Sci*, 68(14): 15-1607.
- [17] Boear, G.C., Osburne, R.C., O'Brian, J.T., Georges, L.P. and Burman, K.D. (1983) Fasting decreases thyrotropin responsiveness to thyrotropin-releasing hormone: a potential cause of misinterpretation of thyroid function tests in the critically ill. *J Clin Endocrinol Metab*, 57(2): 3-380.
- [18] Chaouachi, A., Chamari, K. and Roky, R. (2008) Lipid profiles of judo athletes during Ramadan. *Int J Sports Med*, 29:282-288.
- [19] Dewanti, L.; Watanabe, C.; Sulistiawati and Ohtsuka, R.(2006). Unexpected changes in blood pressure and hematological parameters among fasting and nonfasting workers during Ramadan in Indonesia. *Eur J. Clin. Nutr.* 60(7):877-881.
- [20] El-Hazmi, M.A.F., Al-Faleh, F.Z., Al-Mofleh, I.B. (1987) Effect of Ramadan fasting on the values of hematological and biochemical parameters. *Saudi Med J*, 8: 171-176.
- [21] El-Migdadi, F., Shotar, A., El-Akawi, Z., Banihani, I. and Abudheese, R. (2004) Effect of fasting during the month of Ramadan on serum levels of luteinizing hormone and testosterone in people living in the below sea level environment in the Jordan Valley. *Neuro Endocrinol Lett*, 25(1-2):7-75.
- [22] -Farshidfar, G.h.R., Yousfi, H., Vakili, M. and Asadi Noughabi, F. (2006) The Effect of Ramadan Fasting on Hemoglobin, Hematocrit and Blood Biochemical Parameters. *J Res Health Sci*, 6(2): 21-27.
- [23] Fedail, S.S., Murphy, D., Salih, S.Y., Bolton, C.H., Harvey, R.F. (1982) Changes in certain blood constituents during Ramadan. *Am J Clin Nutr*, 36: 350-353.
- [24] Furuncuoglu, Y., Karaca, E., Aras, S., Yo'ntem, A. (2007). Metabolic, biochemical and psychiatric alterations in healthy subjects during ramadan. *Pakistan Journal of Nutrition*, 6: 209-211.
- [25] Gumaa, K.A., Mustafa, K.Y., Mahmoud, N.A., Gader, A.M. (1978) The effect of fasting in Ramadan. 1. Serum uric acid and lipid concen-

- tration. *Br J Nutr*, 40: 573-581.
- [26] Haghdoost, A.A and Poorranjbar, M.(2009). The interaction between physical activity and fasting on the serum lipid profile during Ramadan. *Singapore Med J*.50(9):897-901.
- [27] Hallak, M.H.and Nomani, M.Z.A. (1988) Body weight loss and changes in blood lipid levels in normal men on hypocaloric diets during Ramadan fasting. *Am J Clin Nutr*, 48: 1197-1210.
- [28] Haouari, M., Haouari-Oukerro, F., Sfaxi, A., Ben Rayana, M.C., Kaabachi, N. and Mbazaa, A. (2008) How Ramadan fasting affects caloric consumption, body weight, and circadian evolution of cortisol serum levels in young, healthy male volunteers. *Horm Metab*,40(8): 7575.
- [29] Hasselbalch, S.G., Knudsen, G.M., Jakobsen, J., Hageman, L.P., Holm, S.and Paulson, O.B. (1995) Blood-brain barrier permeability of glucose and ketone bodies during short-term starvation in humans. *Am J Physiol*, 268: 6-1161.
- [30] Ibrahim, W.H., Habib, H.M., Jarrar, A.H.and Al Baz, S.A. (2008). Effect of Ramadan Fasting on Markers of Oxidative Stress and Serum Biochemical Markers of Cellular Damage in Healthy Subjects. *Annal of Nutrition and Metabolism*, 53(3-4):175-181.
- [31] L. Bogdan, A., Hakkou, F., Amrani N., Abkari, A. and Touitou, Y. (1997). Ramadan diet restrictions modify the circadian time structure in humans. A study on plasma gastrin, insulin, glucose, and calcium and on gastric pH. *Journal of clinical endocrinology and metabolism*, 82(4):73-261.
- [32] Khafaji, H.A.; Bener, A.; Osman, M.; Al Merri, A.and Al Suwaidi, J.(2012). The impact of diurnal fasting during Ramadan on the lipid profile, hs-CRP, and serum leptin in stable cardiac patients. *Vasc .Health .Risk. Manag*. 8:7-14.
- [33] Khaled, M.and Belbraouet, S. (2009) Ramadan Fasting Diet Entailed a Lipid Metabolic Disorder Among Type 2 Diabetic Obese Women. *American Journal of Applied Sciences*, 6(3): 471-477.
- [34] Khan, S.M., Abbas, H.G. and Sabih, U.S.E. (1986) Thyroid disorder in Multan, Pakistan and hormone levels during Ramadan. *Proceedings of International Symposium on Nutritional Techniques in developing countries*, p: 295.
- [35] Kul, S., Savas, E., Ozturk, Z.A.and Karadag, G. (2013) Does Ramadan Fasting Alter Body Weight and Blood Lipids and Fasting Blood Glucose in a Healthy Population? A Meta-analysis. *J Relig Health*.
- [36] Lamri-Senhadji, M.Y., El Kebir, B., Belleville, J.and Bouchenak, M. (2009). Assessment of Dietary Consumption and Time-Course of Changes in Serum Lipids and Lipoproteins Before, During and After Ramadan in Young Algerian Adults. *Singap. Med. J*, 50(3): 288-294.
- [37] Mahboob, S., Sattarivand, R., Nouri, M.and Arefhosseini, S. (1999) Effect of Ramadan fasting on serum lipids profiles in normal and hyperlipidemic subjects. *Saudi Med J*, 20: 50-947.
- [38] Maislos, M., Abou-Rabiah, Y., Zuili, I., Iordash, S.and Shany, S. (1998) Gorging and plasma HDL-cholesterol - the Ramadan model. *Eur J Clin Nutr*, 52: 127-130.
- [39] Maislos, M., Khamaysi, N., Assali, A., Abou-Rabiah, Y., Zvilim, I.and Shany, S. (1993). Marked increase in plasma high-density lipoprotein cholesterol after prolonged fasting during Ramadan. *Am J Clin Nutr*, 57: 640-642.
- [40] Mansi, K.M.S. (2007), Study the Effects of Ramadan Fasting on Serum Glucose and Lipid Profile among Healthy Jordanian Students. *Am. J. Appl. Sci*, 4(8): 565-569.
- [41] Marbut, M. M., Al-Deen, H. ; Al-Najjar, S.M.and Abdulrahman, M. A.(2005). Effect of Ramadan fasting on some physiological parameters. *Medical Journal of Tikrit ; 2: 6-8*.
- [42] Murphy, M. C., Chapman, C., Lovegrove, J. A., Isherwood, S. G., Morgan, L. M. and Wright, J. W. (1996) Meal frequency: Does it determine postprandial lipaemia?. *European Journal of Clinical Nutrition*, 50: 491-497.
- [43] Nagra, S.A., Rahman, Z.U.and Javaria, M. (1998) Study of some biochemical parameters in young women as affected by Ramadan fasting. *International Journal of Ramadan Fasting Research*, 2: 1-5.
- [44] Nigam, P.K. (2011) Serum Lipid Profile: Fasting or Non-fasting?. *Ind J Clin Biochem*, 26(1): 96-97.
- [45] Nomani, M.Z.A. (1997) Dietary fat blood chole-

- terol and uric acid levels during Ramadan fasting. *International Journal of Ramadan Fasting Research*, 1: 1-6.
- [46] Nomani, M.Z.A., Baloch, S.K., Siddiqui, I.P. (1992) Changes in serum cholesterol levels and dietary vegetable-fat at restricted energy intake condition during Ramadan fasting. *International Journal of Food Science & Technology*, 4: 30-36.
- [47] Rahman, M., Rashid, M., Basher, S., Sultana. S., Nomani, M.Z. (2004) Improved serum HDL cholesterol profile among Bangladeshi male students during Ramadan fasting. *East Mediterr Health J*, 10: 131-137.
- [48] Sadiya, A. Ahmed, S. Siddieg, H.H. Babas, I.J. and Carlsson, M. (2011). Effect of Ramadan fasting on metabolic markers, body composition, and dietary intake in Emiratis of Ajman (UAE) with metabolic syndrome. *Diabetes. Metab. Syndr. Obes.* 4:409-416.
- [49] Sajid, K.M., Akhtar, M. and Malik, G.Q. (1991) Ramadan fasting and thyroid hormone profile. *J Pak Med Assoc*, 41(9): 6-213.
- [50] Shahabi, S., Esmaeilzadeh, S., Amiri, M.G., Faramarzi, M., Firouzjahee, A.R. and Esmaeili, T. (2010) Does Islamic Fasting Affect Gonadotropin around Female Ovulation? *International Journal of Fertility and Sterility*, 4(3): 94-97.
- [51] Salehi, M. and Neghab, M. (2007) Effects of fasting and a medium calorie balanced diet during the holy month Ramadan on weight, BMI and some blood parameters of overweight males. *Pak J Biol Sci*, 10: 968-971.
- [52] Saleh, S., Elsharouni, A., Cherian, B., Mourou, M. (2005) Effects of Ramadan fasting on Waist Circumference, Blood Pressure, Lipid Profile, and Blood Sugar on a Sample of Healthy Kuwaiti Men and Women. *Mal J Nutr*, 11(2): 143-150.
- [53] Sariri, R., Varasteh, A and Erfani, A. (2010) Alternations in salivary glucose during ramadan fasting. *HEALTH*, 2: 769-772.
- [54] Schwartz RS, Brunzell JD. (1981). Increase of adipose tissue lipoprotein lipase activity with weight loss. *J Clin Invest.* 1981 May;67(5):1425-30.
- [55] Shehab, A., Abdulle, A., El Issa, A., Al Suwaidi, J., Nagelkerke, N. (2012) Favorable Changes in Lipid Profile: The Effects of Fasting after Ramadan. *PLoS ONE*, 7(10): e47615.
- [56] Shoukry, M.I. (1986) Effect of fasting in Ramadan on plasma lipoproteins and apoproteins. *Saudi Med J*, 7: 561-565.
- [57] Sliman, N. A., Ajlouni, K. S. and Khatib, F. A. (1993) Effect of fasting Ramadan on some blood hormones in healthy Muslim males. *Mu'tah J. Res. Studies*, 8: 91-109.
- [58] Spencer, C.A., Lum, S.M., Wilber, J.F., Kaptein, E.M. and Nicoloff, J.T. (1983) Dynamics of serum thyrotropin and thyroid hormone changes in fasting. *J Clin Endocrinol Metab*, 56(5): 8-883.
- [59] Streja, D.A., Boyko, E. and Rabkin, S.W. (1980) Changes in plasma high-density lipoprotein cholesterol concentration after weight reduction in grossly obese subjects. *British Medical Journal*, 281: 770-772.
- [60] Temizhan, A., Tandogan, I., Donderici, O., Demirbas, B. (2000) The effects of Ramadan fasting on blood lipid levels. *Am J Med*, 109: 341-342.
- [61] Trabelsi, K., el Abed, K., Trepanowski, J.F., Stannard, S.R., Ghlissi, Z., Ghozzi, H., Masmoudi, L., Jammoussi, K. and Hakim, A. (2011) Effects of Ramadan Fasting on Biochemical and Anthropometric Parameters in Physically Active Men. *Asian Journal of Sports Medicine*, 2(3): 134-144.
- [62] R. Nicole, "The Last Word on Decision Theory," *J. Computer Vision*, submitted for publication. (Pending publication)