Journal of Life Sciences Research
ISSN : 2408-9184
Vol. 2, No. 1, 18-24, 2015
http://asianonlinejournals.com/index.php/Lifsc/index

Effects of Fresh, Unprocessed Green Tea *Camelia Sinensis* Extract on Liver Function, Lipid Profile (Cholesterol and Triglycerides), Thyroid Stimulating Hormone (TSH) and Cortisol in Normal Healthy Subjects

***Hamed Khouja*[1*] *--- Haleema AlNahari*[2]**

[1]Department of Medical Laboratory Technology, Faculty of Applied Medical Sciences, King Abdul Aziz University. Saudi Arabia
[2]Department of Biological Sciences, Faculty of Science, King Abdul Aziz University, Girls Sciences College . Saudi Arabia

Abstract

Fresh, unprocessed Green tea*Camelia sinensis*is commonly consumed in several regions of Saudi Arabia. Green tea has been used for centuries as a medical drink. The aim of the study is to investigate the effect of fresh, unprocessedgreen tea on liver function,cholestrol,triglyceride,thyroid stimulating hormone (TSH),and cortisol and in humans. Atotal of 25 healthy adult subjects age range (20-30) years old participated in this study as volunteers.Fresh, unprocessed green tea containing approximately 25 whole stem and leaves (approximately 15g)were given to each volunteer to be used for two weeks with daily consumption between 3-5 cups/day. Pre-drinking fasting blood samples were collected from each volunteerand another fasting blood samples werecollcted again after finshing the period of drinking. The serum collected were assayed for; lipid profile (cholesterol and triglycerides), liver function (total protein,albumin,Alkaline phospatase(ALP), Aspartate aminotransferase(AST),Alanine aminotransferase(ALT), Gamma-glutamyl transferase(GGT) and total bilirubin),thyroid stimulating hormone (TSH) and cortisol.The results showed that unprocessed green tea causes significant increase in albumin,Abumin/ Gloulin ratioand TSH, while it caused significant decrease inglobulins,Triglyceride,Cholestroland ALP.We concluded that fresh unprocessed green tea has powerful specific metabolic activities of intestine, liver, and lipids comparable to green processed tea to improve their functions.

Keywords: Green tea, *Camelia sinensis*is, Liver function, *Cholesterol*, Triglyceride, Cortisol, Thyroid *hormon*

Contents

** Corresponding Author*

1. Introduction

Black tea and green (*Camelia sinensis*) has been used for centuries as a medical drink. It is originated from southern China and intensively cultivated in Asia and in central African countries. Green tea is produced from freshly harvested leaves of the tea plant and they contain water, proteins, carbohydrates, minerals, vitamins and polyphenols of the flavonoid type. The major catechin (flavonoids) present is epigallocatechin gallate. Both green and black tea have medicinal properties, health benefits,various physiological effects and it is treatment of cardiovascular disease,antioxidant, anti-angiogenesis, and antiproliferative assays potentially relevant to the prevention and treatment of various forms of cancer. [1-4]. Fresh, unprocessed green tea leaves with their stem attached are commonly consumed in similar way as normal green tea in Saudi Arabia.

Hyperlipidemia is a risk factor for the development of coronary heart disease [5]. Numerous researches showed natural antioxidants to be effective in correction of elevated blood cholesterol, triglycerides and LDL levels. In this relation application of natural antioxidants for the purpose of the correction of excess weight has gained an active research interest. Numerous researches showed natural antioxidants to be effective in correction of elevated blood cholesterol, triglycerides and LDL levels. [6]. Green tea consumption resulted in enhanced enzyme activities of carbohydrate metabolism and antioxidant defenses, which may lead to improved health.[7-10].

Yan, et al. [11]; Lee, et al. [12]; Al-Sowyan [13]; Senthil Kumaran, et al. [14] and Trautwein, et al. [15] found that green tea extract has been proved to be useful in lowering cholesterol levels thereby slowing down the progression of cardiovascular diseases, obesity and also protect the liver against free radicals. Ramadan, et al. [16] and Roghani and Baluchnejadmojarad [17] supported the hypothesis that both black and green teas may have beneficial effects against the risks of the metabolic syndrome and shown in rat models of human obesity, diabetes and attenuat hepatic lipid peroxidation. Fresh, unprocessed, green tea is commonly consumed by many individuals in Saudi Arabia. So the aim of the study is to investigate the effect of this type of green tea on liver function, Cholestrol, triglyceride, Thyroid stimulating hormone (TSH), and cortisolin normal healthy subjects.

2. Materials and Methods

A total of 25 healthy adult subjects(age range; 20-30) years old volunteered for this study.Fresh, unprocessed green tea were obtained from the local green vegetables wholsale market. Each volunteer was given a bunch of fresh, unprocessed green tea containing approximately 25 whole stem and leaves (15g)to be used for 2 weekswith daily consumption between 3-5 cups**.** Preparation of one cup; 200-250 ml boiled water (one cup) to 1 stem of fresh green tea were added and left for 5 minutes before consuming.Pre-drinking fasting blood sample was collected from each volunteerand another fasting blood sample was collcted again after finshing the period of drinking. The serum collected were assayed for; lipid profile (cholesterol and triglycerides), liver function (total protein,albumin,Alkaline phospatase(ALP), Aspartate aminotransferase(AST),Alanine aminotransferase(ALT), Gamma-glutamyl transferase(GGT) and total bilirubin),thyroid stimulating hormone (TSH) and cortisol.All analytes were measured using the Dimention RxL-Max2 (Dade Behring ,USA) which based on light spectrophotometry .Cortisol and TSH were measured using the Modular Analytic E170(Roche Diagnostics , Germany) by electrochemiluminescenceimmunoassay (ECLIA) techniques .

2.1. Statistical Analysis

Analysis of data was carried out by student's t-test for comparing the means of experimental and control groups [18].

3. Result and Discussion

The result show that fresh, unprocessed green tea cause significant increase in albumin,Albumin/ Gloulin ratioand TSH, while causingsignificant decrease in globulin,Triglyceride,Cholestrolandalkaline phospatase.

Table-1. Effect of fresh, unprocessed green tea on total protein (g/L)albumin(g/L),gloulin (g/L), Abumin/ Gloulin ratio,Alkaline phospatase(ALP) (U/L), Aspartate aminotransferase(AST) (U/L) Alanine aminotransferase(ALT)(U/L),ALT / ASTratio, Gamma-glutamyl transferase(GGT) (U/L),total bilirubin(mmol/L), Thyroid stimulating hormone (TSH)(mu/l), Cholestrol(mmol/L), Triglyceride(mmol/L),and Cortisol(mmol/L) (n=25) .

	before drinking green tea Mean±S.E	**after drinking green tea Mean±S.E**
Total protein(g/L)	74.80±0.8	74.08±0.86
Abumin(g/L)	40.88± 0.63	43.0 ± 0.64*
Globulin(g/L)	33.92 ± 0.62	31.16± 0.83*
Abumin/ Gloulin ratio	1.22± 0.03	1.42± 0.07*
Alkaline phospatase(ALP)(U/L)	43.72± 0.54	40.40± 0.36*
Aspartateaminotransferase(AST)(U/L)	16.64± 0.35	17.36±0.41
Alanine aminotransferase(ALT)(U/L)	30.04 ± 1.29	30.84 ± 2.02
ALT / AST	0.58 ± 0.02	0.60 ± 0.03
Gamma-glutamyltransferase(GGT)(U/L)	21.48 ± 1.49	23.4±0.89
Total bilirubin(µmol/L)	7.20±0.60	7.40± 0.72
Thyroid stimulating hormone(TSH)(mU/L)	2.03± 0.21	2.57± 0.19*
Cholestrol(mmol/L)	4.60 ± 0.11	4.18± 0.11*
Triglyceride(TG)(mmol/L)	0.76± 0.07	0.64± 0.04*
Cortisol(mmol/L)	381.98 ± 24.02	367.06± 27.8

The results are represented as (mean ±S.E) .*$P < 0.05$

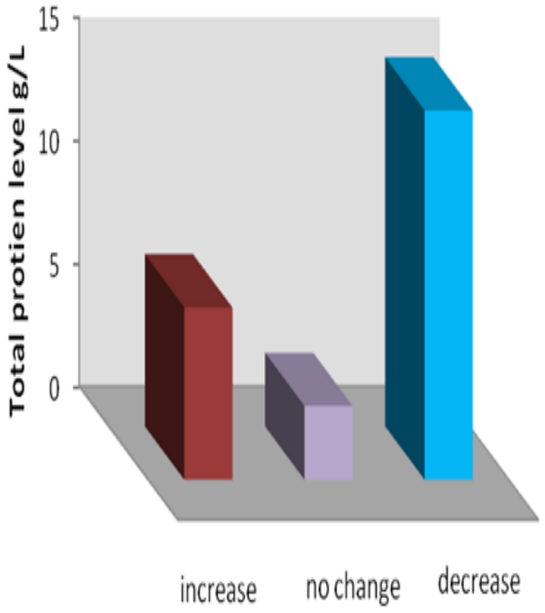

Fig-1. Total protien level (g/L) in normal adult subject drinking green tea

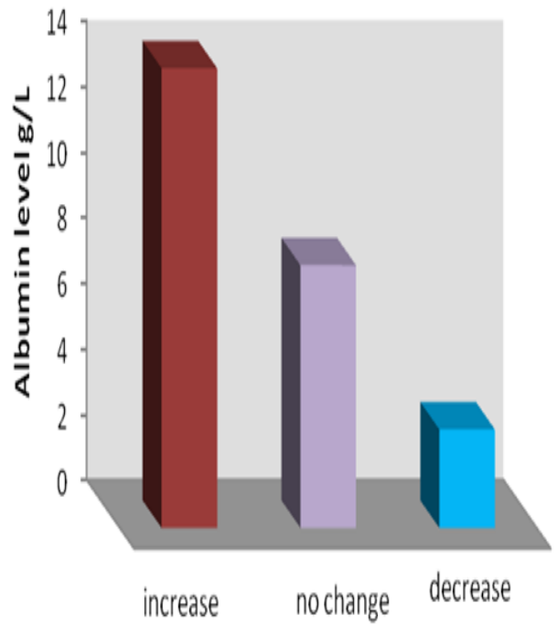

Fig-2. Albumin level (g/L) in normal adult subject drinking green tea

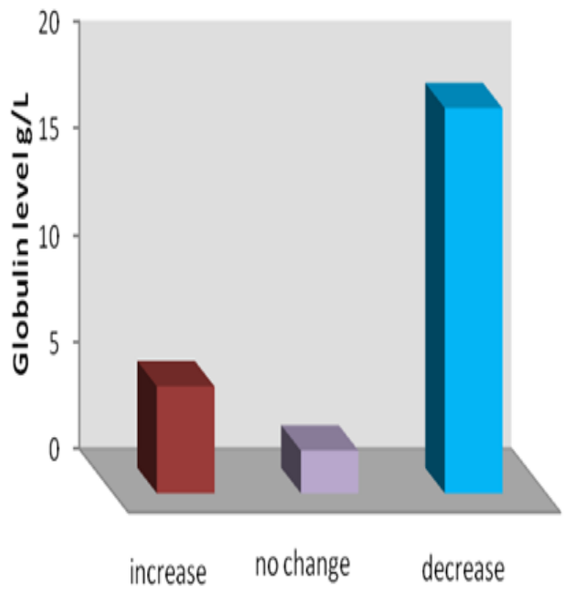

Fig-3. Globulin level (g/L) in normal adult subject drinking green tea

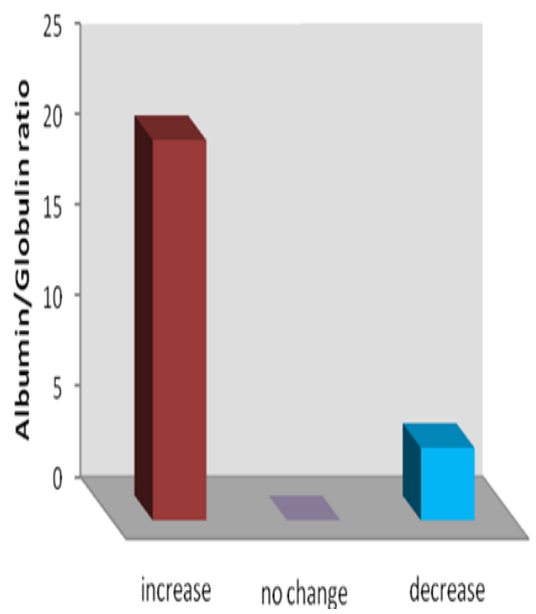

Fig-4. Albumin/Globulin ratio in normal adult subject drinking green tea

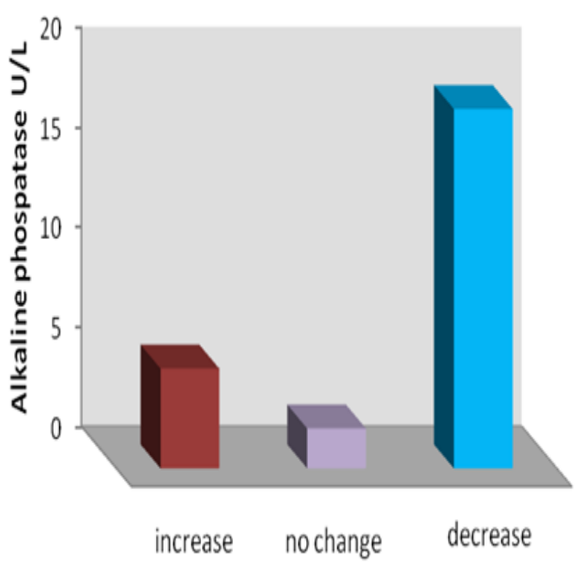

Fig-5. Alkaline phospatase (U/L) in normal adult subject drinking green tea

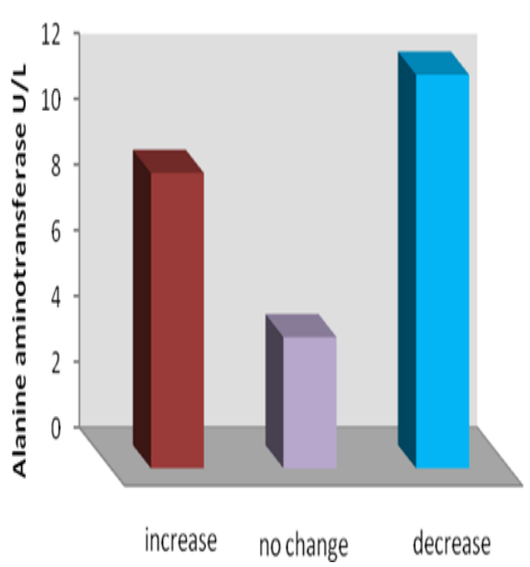

Fig-6. Alanine aminotransferase (U/L) in normal adult subject drinking green tea

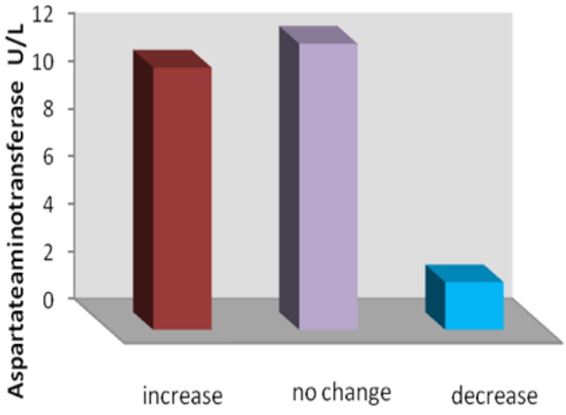

Fig-7. Aspartateaminotransferase (U/L) in normal adult subject drinking green tea

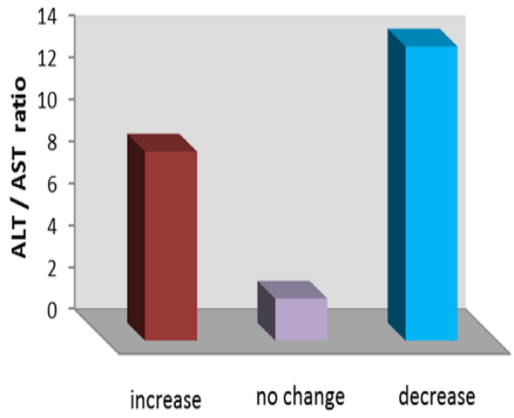

Fig-8. ALT/AST ratio in normal adult subject drinking green tea

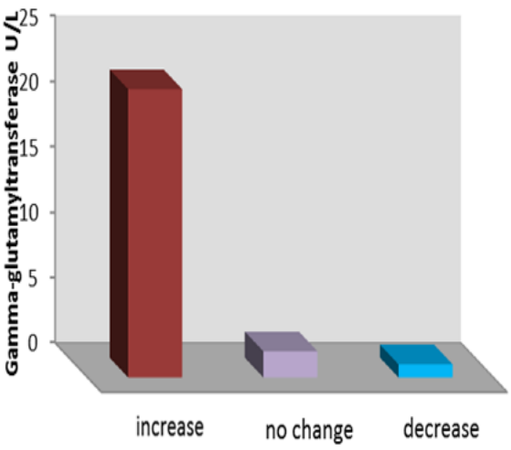

Fig-9. Gamma_glutamyltransferase (U/L) in normal adult subject drinking green tea

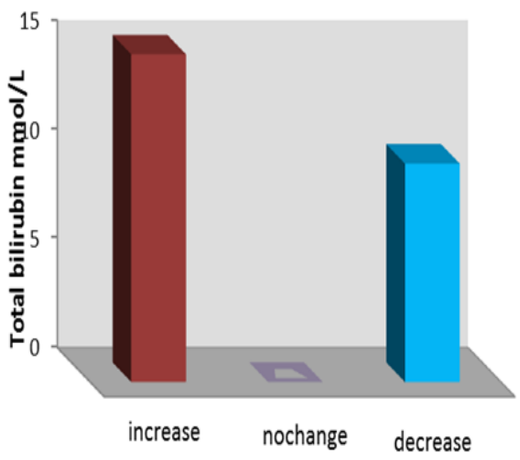

Fig-10. Total bilirubin (mmol/L) in normal adult subject drinking green tea

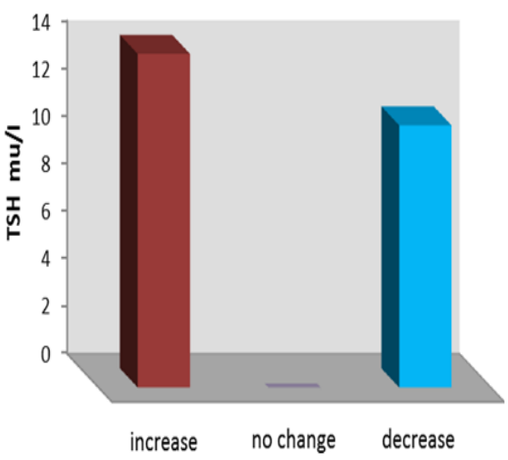

Fig-11. Thyriod stimulating hormone (mu/l) in normal adult subject drinking green tea

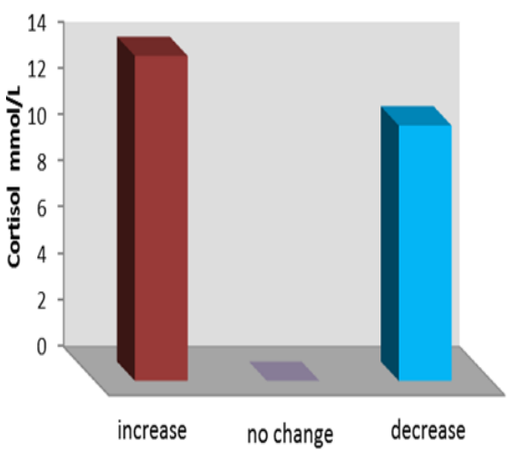

Fig-12. Cortisol (mmol/L) in normal adult subject drinking green tea

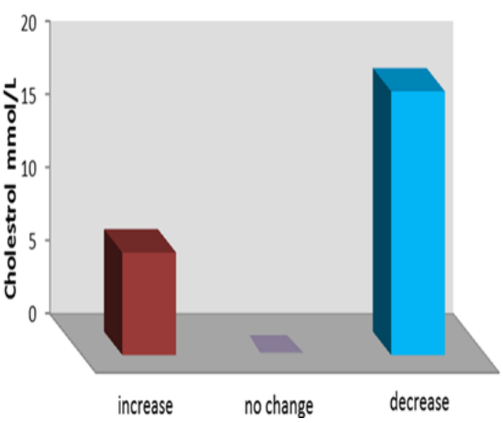

Fig-13. Chorlestrol (mmol/L) in normal adult subject drinking green tea

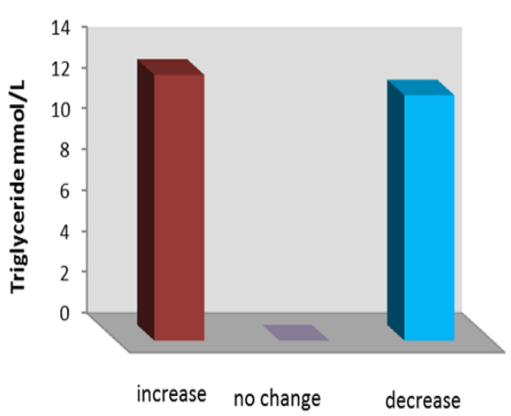

Fig-14. Triglyceride(TG) (mmol/L) in normal adult subject drinking green tea

Fresh, unprocessed green tea is commonly consumed in many areas of Saudi Arabia. While most of the literature and research deal mainly with processed green tea, reference to fresh, unprocessed green tea is very rare. This makes this study unique both in its application and results. It constitutes one of the basic or pilot studies of its kind. In this study, pre- and post-drinking findings are compared for each volunteer and our discussion compare our findings to those reported in the literature by various invstigators of green processed tea.The results showthat fresh, unprocessed green tea resulted in significant decrease intriglyceride and cholestrol .These observations are in agreement with the findings of several workers who have investigated the effects of green tea oncholestrolandtriacylglyceride Shirai and Suzuki [19]; Chanadiri, et al. [6]; Lin and Lin-Shiau [20];Nagao, et al. [21]; Fujita and Yamagami [22]); Hooper, et al. [23]; Al-Sowyan [13]; Richard, et al. [24]; and Tsai, et al. [25] who found that green tea decreases total cholesterol, LDL cholesterol and triacylglycerol in animals and in man.The data suggest the effect of green tea oncholestrolandtriacylglyceride which could be due to inhibiting cholesterol absorption in the intestines, inhibition of the synthesis of cholesterol in the liver and in whole cellsby suppression of enzyme activities for fatty acid synthesis,upregulation of the low-density lipoprotein (LDL) and lowered the generation of hydroxyl radical and elevated serum antioxidative by increasing HDL cholesterol levels. Raederstorff, et al. [26]; Kobayashi, et al. [27] ;Wang , et al. [28]; Fallon, et al. [29]; Matsui , et al. [30]; Park, et al. [31] and Sogawa, et al. [32] reported that green tea leaves induced a decrease in the liver cholesterol and triglyceride levels and an increase in the fecal excretion of cholesterol. These results indicate tea-leaf saponins to be the active components exhibited antihypercholesterolemic activity by inhibiting cholesterol absorption in the intestines and through the increase in fat energy consumption not due to inhibition of synthesis of cholesterol or fatty acid.Yang and Koo [33] and Annaba , et al. [34] demonstrated that green tea exhibit hypocholesterolemic effects probably via their inhibitory effects on intestinal bile acid absorption. Apical Sodium-Dependent Bile Acid Transporter (ASBT) is responsible for reabsorption of bile acids.

Hasegawa , et al. [35]; Bursill and Roach [36] and Singh, et al. [37] found that that the hypocholesterolemic activity of powdered green tea might be due to the inhibition of the synthesis of cholesterol in the liver and in whole cells. This indicates that, green tea increases cellular cholesterol efflux. Wolfram, et al. [38] and Kim, et al. [39] found that a reduction of hepatic triglyceride content and adipose tissue weight in the green tea group was related to the suppression of enzyme activities for fatty acid synthesis without affecting fatty acid oxidation enzyme activities in hepatic and adipose tissue.

Yang and Koo [33]; Miura , et al. [40]; Osada, et al. [41]; Yokozawa, et al. [42] and Inami, et al. [43] demonstrated that green tea significantly prevented endothelial cell induced LDL oxidation,green tea lowered the generation of hydroxyl radical and elevated serum antioxidative by increasing high-density lipoprotein (HDL) cholesterol levels.

Hernández Figueroa, et al. [1]. concluded that green tea and its catechins consumptions (i) decrease body weight by interfering within the sympathoadrenal system and fatty acid synthesis, (ii) decrease cholesterol absorption and plasma levels, (iii) have strong free radical-scavenging activity inhibiting LDL oxidation, (iv) reduce the adhesion molecule expression.

The results show that fresh, unprocessed green tea can improve liver function by causing significant increase in albuminand Abumin/ Gloulin ratio and significant decrease in alkalinephospatase (ALP). Significant increase in albumin may well be due to the increased albuminintravascular movement or inhibition of protein nitration [44, 45] and [46, 47].

The observed decrease in ALP may suggest liver involvement .This is supported by no change in other liver enzymes. The liver appeared to be well protected during drinking green tea . Okamoto, et al. [48] and Ojo, et al. [49] found that green tea reduced ALP .

The result show that green teacause significant increase in TSH this is agreement with Sakamoto, et al. [50]; Satoh, et al. [51]; El Mgeed, et al. [52] found that green tea extract induced elevating plasma thyroid stimulating hormone (TSH).

We concluded that in our study fresh, unprocessed green tea has powerful specific metabolic activities of intestine, liver, and lipids to improve their functions which were found to be similar to green processed tea.

References

[1] T. T. Hernández Figueroa, E. Rodríguez-Rodríguez, and F. J. Sánchez-Muniz, "The green tea, a good choice for cardiovascular disease prevention?," *Arch. Latinoam Nutr.*, vol. 54, pp. 380-394, 2004.

[2] T. Nagao, Y. Komine, S. Soga, S. Meguro, T. Hase, Y. Tanaka, and I. Tokimitsu, "Ingestion of a tea rich in catechins leads to a reduction in body fat and malondialdehyde-modified LDL in men," *Am. J. Clin. Nutr.*, vol. 81, pp. 122-129, 2005.

[3] R. Cooper, D. J. Morré, and D. M. Morré, "Medicinal benefits of green tea: Part I. Review of noncancer health benefits," *J Altern Complement Med.*, vol. 11, pp. 521-528, 2005.

[4] S. I. Koo and S. K. Noh, "Green tea as inhibitor of the intestinal absorption of lipids: Potential mechanism for its lipid-lowering effect," *J. Nutr. Biochem.*, vol. 18, pp. 179-183, 2007.

[5] M. P. McGowan and S. Proulx, "Nutritional supplements and serum lipids: Does anything work?," *Curr Atheroscler Rep.*, vol. 11, pp. 470-476, 2009.

[6] T. Chanadiri, T. Sanikidze, M. Esaishvili, I. Chkhikvishvili, and I. Datunashvili, "Effectiveness of green tea catechines for the correction of the alimentary obesity in the experiment," *Georgian Med News*, vol. 23, pp. 61-63, 2005.

[7] W. L. Yee , Q. Wang, T. Agdinaoay, K. Dang, H. Chang, A. Grandinetti, A. A. Franke, and A. Theriault, "Green tea catechins decrease apolipoprotein B-100 secretion from HepG2 cells," *Mol Cell Biochem*, vol. 229, pp. 85-92, 2002.

[8] S. A. Khan, S. Priyamvada, N. A. Arivarasu, S. Khan, and A. N. Yusufi, "Influence of green tea on enzymes of carbohydrate metabolism, antioxidant defense, and plasma membrane in rat tissues," *Nutrition*, vol. 23, pp. 687-95, 2007.

[9] M. Tuzcu , N. Sahin, M. Karatepe, G. Cikim, U. Kilinc, and K. Sahin, "Epigallocatechin-3-gallate supplementation can improve antioxidant status in stressed quail," *Br Poult Sci.*, vol. 49, pp. 643-648, 2008.

[10] P. Eichenberger, P. C. Colombani, and S. Mettler, "Effects of 3-week consumption of green tea extracts on whole-body metabolism during cycling exercise in endurance-trained men," *Int. J. Vitam. Nutr. Res.*, vol. 79, pp. 24-33, 2009.

[11] Y. Yan, X. Zhao, L. Zhang, and F. Liu, "Effect of a complex tea on reducing blood lipid in rabbits," *Wei Sheng Yan Jiu*, vol. 30, pp. 52-54, 2001.

[12] M. S. Lee, J. Y. Park, H. Freake, I. S. Kwun, and Y. Kim, "Green tea catechin enhances cholesterol 7alpha-hydroxylase gene expression in Hep G2 cells," *Br J Nutr.*, vol. 99, pp. 1182-1185, 2008.

[13] N. S. Al-Sowyan, "Difference in leptin hormone response to nutritional status in normal adult male albino rats," *Pak J Biol Sci.,* vol. 15-12, pp. 119-126, 2009.

[14] V. Senthil Kumaran, K. Arulmathi, R. Sundarapandiyan, and P. Kalaiselvi, "Attenuation of the inflammatory changes and lipid anomalies by epigallocatechin-3-gallate in hypercholesterolemic diet fed aged rats," *Exp. Gerontol.,* vol. 44, pp. 745-751, 2009.

[15] E. A. Trautwein, Y. Du, E. Meynen, X. Yan, Y. Wen, H. Wang, and H. O. Molhuizen, "Purified black tea theaflavins and theaflavins/catechin supplements did not affect serum lipids in healthy individuals with mildly to moderately elevated cholesterol concentrations," *Eur. J .Nutr.,* vol. 49, pp. 27-35, 2010.

[16] G. Ramadan, N. M. El-Beih, and E. A. Abd El-Ghffar, "Modulatory effects of black v. green tea aqueous extract on hyperglycaemia, hyperlipidaemia and liver dysfunction in diabetic and obese rat models," *Br. J. Nutr.,* vol. 102, pp. 1611-1619, 2009.

[17] M. Roghani and T. Baluchnejadmojarad, "Hypoglycemic and hypolipidemic effect and antioxidant activity of chronic epigallocatechin-gallate in streptozotocin-diabetic rats," *Pathophysiology,* vol. 17, pp. 55-59, 2009.

[18] R. M. Spiegel, "Theory and problems of statistic, schaum`s out lin series," ed Singapore: McGraw-Hill, 1981.

[19] N. Shirai and H. Suzuki, "Effects of Western, vegetarian, and Japanese dietary fat model diets with or without green tea extract on the plasma lipids and glucose, and liver lipids in mice. A long-term feeding experiment," *Ann Nutr Metab.,* vol. 48, pp. 95-102, 2004.

[20] J. K. Lin and S. Y. Lin-Shiau, "Mechanisms of hypolipidemic and anti-obesity effects of tea and tea polyphenols," *MolNutr Food Res.,* vol. 50, pp. 211-217, 2006.

[21] T. Nagao, T. Hase, and I. Tokimitsu, "A green tea extract high in catechins reduces body fat and cardiovascular risks in humans," *Obesity (Silver Spring),* vol. 15, pp. 1473-1483, 2007.

[22] H. Fujita and T. Yamagami, "Extract of black tea (Pu-Ehr) inhibits postprandial rise in serum cholesterol in mice, and with long term use reduces serum cholesterol and low density lipoprotein levels and renal fat weight in rats," *Phytother .Res.T.,* vol. 22, pp. 1275-1281, 2008.

[23] L. Hooper, P. A. Kroon, E. B. Rimm, J. S. Cohn, I. Harvey, K. A. Le Cornu, J. J. Ryder, W. L. Hall, and A. Cassidy, "Flavonoids, flavonoid-rich foods, and cardiovascular risk: A meta-analysis of randomized controlled trials," *Am J Clin Nutr.,* vol. 38, pp. 38-50, 2008.

[24] D. Richard, K. Kefi , U. Barbe, A. Poli, P. Bausero, and F. Visioli, "Weight and plasma lipid control by decaffeinated green tea," *Pharmacol Res.,* vol. 59, pp. 351-354, 2009.

[25] C. H. Tsai, W. C. Chiu, N. C. Yang, C. M. Ouyang, and Y. H. Yen, "A novel green tea meal replacement formula for weight loss among obese individuals: a randomized controlled clinical trial," *Int. J .Food. Sci. Nutr.,* vol. 7, pp. 1-9, 2009.

[26] D. G. Raederstorff, M. F. Schlachter, V. Elste, and P. Weber, "Effect of EGCG on lipid absorption and plasma lipid levels in rats," *J Nutr Biochem.,* vol. 14, pp. 326-332, 2003.

[27] M. Kobayashi, T. Unno, Y. Suzuki, A. Nozawa, Y. Sagesaka, T. Kakuda, and I. Ikeda, "Heat-epimerized tea catechins have the same cholesterol-lowering activity as green tea catechins in cholesterol-fed rats," *Biosci Biotechnol Biochem.,* vol. 69, pp. 2455-2458, 2005.

[28] S. Wang , S. K. Noh , and S. I. Koo, "Epigallocatechin gallate and caffeine differentially inhibit the intestinal absorption of cholesterol and fat in ovariectomized rats," *J .Nutr.,* vol. 136, pp. 2791-2796, 2006.

[29] E. Fallon, L. Zhong, J. K. Furne, and M. Levitt, "A mixture of extracts of black and green teas and mulberry leaf did not reduce weight gain in rats fed a high-fat diet," *Altern Med. Rev.,* vol. 13, pp. 43-49, 2008.

[30] Y. Matsui , K. Kobayashi, H. Masuda, H. Kigoshi, M. Akao, H. Sakurai, and H. Kumagai, "Quantitative analysis of saponins in a tea-leaf extract and their antihypercholesterolemic activity," *Biosci Biotechnol Biochem,* vol. 73, pp. 1513-1519, 2009.

[31] J. H. Park, J. Y. Jin, W. K. Baek, S. H. Park, H. Y. Sung, Y. K. Kim, J. Lee, and D. K. Song, "Ambivalent role of gallated catechins in glucose tolerance in humans: A novel insight into non-absorbable gallated catechin-derived inhibitors of glucose absorption," *J .Physiol. Pharmacol.,* vol. 60, pp. 101-109, 2009.

[32] M. Sogawa, T. Seura, S. Kohno, K. Hirasaka, Y. Yamaguchi, R. Takagaki, A. Harada, Y. Okumura , S. Yamamoto, K. Kishi, and T. Nikawa, "Awa (Tokushima) lactate-fermented tea as well as green tea enhance the effect of diet restriction on obesity in rats," *J. Med. Invest.,* vol. 56, pp. 42-48, 2009.

[33] T. T. Yang and M. W. Koo, "Inhibitory effect of Chinese green tea on endothelial cell-induced LDL oxidation," *Atherosclerosis,* vol. 148, pp. 67-73, 2000.

[34] F. Annaba , P. Kumar, A. K. Dudeja, S. Saksena, R. K. Gill, and W. A. Alrefai, "Green tea catechin (-)-Epigallocatechin-3-Gallate (EGCG) Inhibits Ileal apical sodium bile acid transporter ASBT.Am," *J. Physiol.Gastrointest. Liver. Physiol,* vol. 7, 2010.

[35] N. Hasegawa , N. Yamda, and M. Mori, "Powdered green tea has antilipogenic effect on Zucker rats fed a high-fat diet. Phytother," *Res.,* vol. 17, pp. 477-480, 2003.

[36] C. A. Bursill and P. D. Roach, "Modulation of cholesterol metabolism by the green tea polyphenol (-)-epigallocatechin gallate in cultured human liver (HepG2) cells," *J. Agric. Food. Chem.,* vol. 8-54, pp. 1621-1626, 2006.

[37] D. K. Singh, S. Banerjee, and T. D. Porter, "Green and black tea extracts inhibit HMG-CoA reductase and activate AMP kinase to decrease cholesterol synthesis in hepatomacells," *J Nutr Biochem.,* vol. 20, pp. 816-822, 2009.

[38] S. Wolfram, Y. Wang, and F. Thielecke, "Anti-obesity effects of green tea: From bedside to bench," *Mol.Nutr. Food .Res.,* vol. 50, pp. 176-187, 2006.

[39] H. J. Kim, S. M. Jeon, M. K. Lee, U. J. Jung, S. K. Shin, and M. S. Choi, "Antilipogenic effect of green tea extract in C57BL/6J-Lep ob/ob mice," *Phytother Res.,* vol. 23, pp. 467-671, 2009.

[40] Y. Miura , T. Chiba, I. Tomita, H. Koizumi, S. Miura, K. Umegaki, Y. Hara, M. Ikeda , and T. Tomita, "Tea catechins prevent the development of atherosclerosis in apoprotein E-deficient mice," *J. Nutr.,* pp. 27-32, 2001.

[41] K. Osada, M. Takahashi, S. Hoshina, M. Nakamura, S. Nakamura, and M. Sugano, "Tea catechins inhibit cholesterol oxidation accompanying oxidation of low density lipoprotein in vitro.Comp," *BiochemPhysiol C Toxicol Pharmacol.,* vol. 128, pp. 153-164, 2001.

[42] T. Yokozawa, T. Nakagawa, and K. Kitani, "Antioxidative activity of green tea polyphenol in cholesterol-fed rats," *J Agric Food Chem.,* vol. 5-50, pp. 3549-3552, 2002.

[43] S. Inami, M. Takano, M. Yamamoto, D. Murakami, K. Tajika, K. Yodogawa, S. Yokoyama, N. Ohno, T. Ohba, J. Sano, C. Ibuki, Y. Seino, and K. Mizuno, "Tea catechin consumption reduces circulating oxidized low-density lipoprotein," *Int Heart J.,* vol. 48, pp. 725-32, 2007.

[44] R. Boch, N. Mohtat, Y. Lear, J. T. Arnason, T. Durst, and J. C. Scaiano, "Study of photoinduced energy and electron transfer in alpha-terthienyl-bovine serum albumin conjugates: A laser flash photolysis study," *Photochem. Photobiol.,* vol. 64, pp. 92-99, 1996.

[45] F. Van Hunsel, A. Van Gastel, H. Neels, A. Wauters, P. Demedts, K. Bruyland, I. DeMeester, S. Scharpé, A. Janca, C. Song, and M. Maes, "The influence of psychological stress on total serum protein and patterns obtained in serum protein electrophoresis," *Psychol. Med.,* vol. 28, pp. 301-309, 1998.

[46] K. E. Fallon, G. Sivyer, K. Sivyer, and A. Dare, "The biochemistry of runners in a 1600 km ultramarathon," *Br. J. Sports. Med.,* vol. 33, pp. 264-269, 1999.

[47] M. Bixby, L. Spieler, T. Menini , and A. Gugliucci, "Ilex paraguariensis extracts are potent inhibitors of nitrosative stress: a comparative study with green tea and wines using a protein nitration model and mammalian cell cytotoxicity," *Life Sci.,* vol. 3-77, pp. 345-358, 2005.

[48] M. Okamoto, K. P. Leung, T. Ansai, A. Sugimoto, and N. Maeda, "Inhibitory effects of green tea catechins on protein tyrosine phosphatase in prevotellaintermedia," *Oral. Microbiol. Immunol.,* vol. 18, pp. 192-195, 2003.

[49] O. O. Ojo, O. Ladeji, and M. S. Nadro, "Studies of the antioxidative effects of green and black tea (Camellia Sinensis) extracts in rats," *J. Med .Food.,* vol. 10, pp. 345-349, 2007.

[50] Y. Sakamoto, H. Mikuriya, K. Tayama, H. Takahashi, A. Nagasawa, N. Yano, K. Yuzawa, A. Ogata, and N. Aoki, "Goitrogenic effects of green tea extract catechins by dietary administration in rats," *Arch Toxicol.,* vol. 75, pp. 591-596, 2001.

[51] K. Satoh, Y. Sakamoto, A. Ogata, F. Nagai, H. Mikuriya, M. Numazawa, K. Yamada, and N. Aoki, "Inhibition of aromatase activity by green tea extract catechins and their endocrinological effects of oral administration in rats," *Food. Chem. Toxicol.*, vol. 40, pp. 925-933, 2002.

[52] A. A. El Mgeed, M. Bstawi, U. Mohamed, and M. A. Gabbar, "Histopathological and biochemical effects of green tea and/or licorice aqueous extracts on thyroid functions in male albino rats intoxicated with dimethylnitrosamine," *NutrMetab (Lond)*, vol. 12-6, p. 12, 2009.