American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)

ISSN (Print) 2313-4410, ISSN (Online) 2313-4402

http://asrjetsjournal.org/

Benefits of Asam Gelugur (*Garcinia atroviridis*) Tea as a Source of Antioxidant Compounds on Malondialdehyde Levels in Adults with Obesity

Christina J. R. E. Lumbantobing[a]*, Sumaryati Syukur[b], Eti Yerizel[c], Endang Purwati[d]

[a]*Department of Internal Medicine, Faculty of Medicine, University of Methodist Indonesia, Medan 20132, Indonesia*

[b]*Laboratory of Biotechnology, Department of Chemistry, Faculty of Mathematic and Natural Science, University of Andalas, Padang 25613, Indonesia*

[c]*Laboratory of Biomedic, Faculty of Medicine, University of Andalas, Padang 25613, Indonesia*

[d]*Laboratory of Nutrition, Faculty of Animal Husbandry, University of Andalas, Padang 25613, Indonesia*

[a]*Email: lumbantobingchris@gmail.com*

[b]*Email: purwati17@yahoo.co.id*

Abstract

Garcinia atroviridis is one of the well-known plant grown in Indonesia that contains antioxidant compounds. Ingestion of *G.atroviridis* tea is expected to protect from oxidative stress. The aim of the this study was to evaluate the antioxidative benefit of *G.atroviridis* leaf tea on malondialdehyde levels of obese adults. This research recruited fifteen obese adults. All of the subjects were given *G.atroviridis tea* for a month. As a result, current study obtained statistically nonsignificant differences of post-test malondialdehyde levels compared with pre-test levels among all subjects. It can be concluded that *G.atroviridis* tea taken once daily for 30 days was not sufficient to decrease MDA levels significantly. Although anthropometric measures decreased significantly, the subjects were still in the criteria of obesity. In addition, the lifestyle factors that increases MDA should be avoided.

Keywords: malondialdehyde; *G.atroviridis*; obesity; oxidative stress.

---

* Corresponding author.

1. Introduction

Obesity is associated with oxidative stress which can be reduced with weight loss (regardless of exercise or surgery induced weight loss), caloric restriction or antioxidant rich diets. Oxidative stress levels are elevated in human obesity [1]. NADPH oxidase is the major source of ROS in adipocytes, augmented NADPH oxidase contributes to increase ROS production in adipose tissue in obesity, resulted increased levels of fatty acid in accumulated fat stimulate ROS production in adipose cells through the activation of NADPH oxidase. ROS downregulated adiponectin expression at the transcriptional level, hence treatment with antioxidants or inhibitors of ROS production might restore the dysregulation of adipocytokines. Increased oxidative stress in accumulated fat is an early instigator of metabolic syndrome and the redox state in adipose tissue is a potentially useful therapeutic target for obesity-associated metabolic syndrome [2]. Not only adiponectin, obesity also alters the adipokines balance produced by adipocytes, with elevated leptin, TNF-α, RBP4, resistin, and IL6. Changes in the balance contribute to impaired glucose tolerance and insulin resistance [3].

Triacylglycerol is a high concentrated deposit of metabolic energy. In mammals, the main location of TAG accumulation is in the cytoplasm of adipose cells. Adipose cells are devoted to the synthesis and storage of TAG, and mobilization into the fuel molecules [4]. In obesity, increased TNF-α released to the liver further increases the production of ROS during β-oxidation mitochondrial to FFA. Upregulation of FFA microsomal and peroxisomal oxidation will contribute to oxidative stress. Oxidative stress leads to lipid peroxidation in liver [5]. Excessive formation of ROS causes lipid peroxidation of cellular membranes, and causes release of TNF-α [6]. Preadipocyte and adipocyte in excessive adipose tissue is a source of proinflammatory cytokines (eg TNF-α, IL-1, IL-6), hence obesity is considered a chronic inflammatory state. Increased cytokine concentration is responsible for the increase in oxidative stress. The cytokine is a potent stimulator for producing ROS/RNS by macrophages and monocytes. TNF-α also increases the interaction of electrons with oxygen to produce superoxide anions [7]. Free radicals or ROS at high levels can cause direct damage to lipids. Lipid peroxidation is a process in which oxidants attack lipids containing carbon-carbon double bonds (s) , resulting in the production of peroxyl lipid radicals and hydroperoxide [8]. Lipids are the targets of oxidant compounds, which can initiate lipid peroxidation processes. In medium or high rate of lipid peroxidation, the extent of oxidative damage exceeds its repair capacity. Many studies have analyzed the danger effects of lipid oxidation in cell membranes[8], [9], [10], [11]. Lipid peroxidation is a chain reaction that results in multiple breakdown - molecules, such as malondialdehyde (MDA) and 4-HNE. Various biomarkers of lipid peroxidation exist, among which are malondialdehyde (MDA).

Antioxidants are defined as any substance which, if present in a lower concentration than the oxidized substrate, may delay or inhibit the oxidation of the substrate. The role of antioxidants is to prevent damage to cellular components that arise as a consequence of chemical reactions involving free radicals [12]. Human body requires antioxidants to reduce the effects of free radicals. Garcinia species are rich sources of mangostin, tannin, xanthone, isoflavone, flavones, and other bioactive substances [13], [14]. As a popular plant in Indonesia *G.atroviris* (asam gelugur) is one source of exogenous natural antioxidants, this plant contains chemical compounds with many benefits. Study findings indicate the potential use of *G. atroviridis* leaves and fruits as a source of natural antioxidants [15] The leaves of Garcinia have higher antioxidant activity than their stems. It

was shown that the total phenolic content showed a good correlation with the antioxidant activity [13],[16]. Based on these background, it is necessary to conduct a study about the effect of *G.atroviridis* tea produced in Indonesia on serum MDA levels of obese adults.

2. Materials and Methods

This research was conducted with pre and post test design. Fifteen obese adults were recruited. *G.atroviridis* leaf tea made from a sachet of *dried leaf* brewed in 200 ml water and taken by all subjects for a month. At the beginning of the study, waist cirumference, body weight, and body height off all subjects were measured to determine anthropometric status and body mass index. All study subjects were educated about nutritious diet, recommended to avoid lifestyle with less activity, and walk at least three times a week. For the measurement of lipid indices, the procedure was similar to that described elsewhere and by Syukur and his colleagues[17]. The study was approved by Ethical Committee of Faculty of Medicine University of Andalas, Padang - Sumatra Barat.

3. Results

Figure 1 demonstrated pre-test measurement of body mass index and waist circumference compared with the post-test measurement, the BMI and WC measurements of subjects were significantly decreased with p value < 0.05.

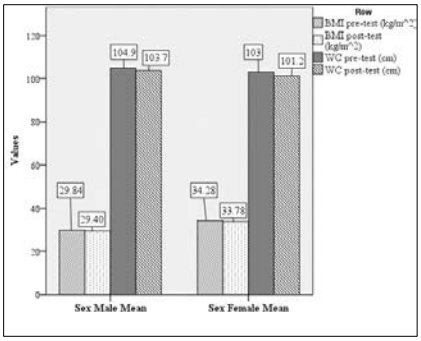

Figure 1: Comparison between BMI and WC pre-test and post test of subjects.

The decrease of BMI and WC were found in male and female subjects (Table 1).

Table 1: Pre- and post-test measurements of waist circumference and body mass index

	Body Mass Index (kg/m^2) (mean± SD)		Waist Circumference (cm) (mean± SD)	
	Pre-Test	Post-Test	Pre-Test	Post-Test
Male	29,84 ± 3,16	29.40 ± 3.14	104. 90 ± 8.12	103,70 ± 7,56
Female	34,28 ± 1,99	33.78 ± 1.94	103.00 ± 6.36	101.20 ± 6.22

Table 2 below shows the average pre-test FBG level is 172.67 ± 130.91 mg / dL. The mean post-test FBG level is 117.53 ± 53.96 mg / dL. Using the statistical test, FBG pre-test levels were found to be significantly different (p value 0.002) with post-test FBG.

Table 2: The influence of *G.atroviridis* tea on the levels of FBG, triglyceride and malondialdehyde

	Body Mass Index (kg/m^2) (mean ± SD)		p
	Pre-Test	Post-Test	
Fasting Blood Glucose (mg/dL)	172.67 ± 130.91	117.53 ± 53.96	0.002
Triglyceride levels (mg/dL)	241.40 ± 211.44	166.0 ± 97.23	0.04
Malondialdehyde levels (μmol/L)	0.82 ± 0.15	0.78 ± 0.13	0.23

There were significant clinical and statistical differences of pre-test FBG with post-test FBG. The results of this study are supported by a previous study which stated that *G.atroviridis* contains (-) - HCAs that act as ATP citrate lyase inhibitors [18,19]. The use of *G.atroviridis* was followed by a significant decrease in mean body weight compared with control without affect appetite [20]. This results supported by previous study which suggested that HCA may slow the absorption of enteral glucose. Besides, oral HCA supplementation significantly accelerated the speed of glycogen synthesis up to twofold in human skeletal muscle after exercise, and increased the synthesis rate of glycogen along with increased insulin sensitivity throughout the body [21].

In the table 2, the pre-test triglyceride level was 241.40 ± 211.44 mg/dL and the post-test level was 166.0 ± 97.23 mg/dL (*p*- value 0.04). Previous report stated that TG levels, and MDA LDL were closely correlated [22], while another study reported that *G.atroviridis* has been proven to be useful in lowering triglyceride levels [23]. However, significant decrease of TG levels obtained in this study was not accompanied with reduced in MDA levels. The type and amount of food consumed, and the smoking cigarettes by the subject in current research was not controlled. Besides, all of the lifestyle mentionded above may play role and influencing MDA levels.

Garcinia has antioxidant abilities against oxidative damage in *in vitro* system [24]. The proton-donating ability of *G. atroviridis* extracts which could serve as free radical inhibitor and act as a primary antioxidant. The reducing power of leaf extracts of *G.atroviridis* was superior to the fruit extracts. Previous study demonstrated that the leaves of *G.atroviridis* were rich in phenolics and higher concentrations obtained when extracted at 100°C for 15 min. The increased total phenolic concentrations in the leaf was proportional to increased antioxidant activities [15]. In current study, the pre-test MDA level was 0.82 ± 0.15 μmol / L and after thirty days, the post-test MDA level was 0.78 ± 0.13 μmol / L. Statistical analysis results obtained *p* value 0.23. Current study obtained a difference in pre-test and post-test MDA mean as much as 0.03 μmol / L. Statistically, there was no significant difference between post-test with pre-test MDA. It is concluded that the clinical difference is very small, and not statistically significant. Many factors can affect MDA levels. It was already

known, as a targets of oxidant compounds, lipid can initiate lipid peroxidation processess, and the reaction results in production of molecules such as malondialdehyde. In increased rate of lipid peroxidation, as in obese state, the extent of oxidative damage was beyond the repair capacity and antioxidant available for reducing free radicals. Besides, the subject of this study was not fully supervised for their lifestyles, smoke behaviour, and food intake. Repeated anamnestic interview found that some subjects remained smoking cigarettes [24]. Hence, the limitations of this study consisted of unsupervised of food consumption and smoking cigarettes. It is advisable to extend the treatment period in order to observe more of the benefits of *g.atroviridis* tea on decreasing body mass index and MDA levels.

4. Conclusion

This study concluded that once-daily consumption of Garcinia tea was not enough to significantly decrease the MDA levels despite the significant decrease in BMI, WC, as well as significant decline of FBG and TG levels. Eventhough the anthropometric measurements reduced significantly, the subjects were still in the criteria of obesity. In addition, we suggested to prolong treatment period, and avoid lifestyle behaviours that increases MDA.

Acknowledgements

I would like to express my appreciation to PT Prodia Widya Husada for providing clinical laboratory facilities.

References

[1] H. K. Vincent, A. G. Taylor. "Biomarkers and potential mechanisms of obesity-induced oxidant stress in humans". International Journal of Obesity.vol.30, pp. 400–18, 2006.

[2] S. Furukawa, T. Fujita, M. Shimabukuro, M. Iwaki, Y. Yamada, Y. Nakajima, et al. "Increased oxidative stress in obesity and its impact on metabolic syndrome". The Journal of Clinical Investigation. vol.114, pp. 1752–61, 2004.

[3] A. D. Attie, P. E. Scherer. "Adipocyte metabolism and obesity". Journal of Lipid Research. vol.50, pp. S395–9, 2009 .

[4] J. M. Berg, J. L. Tymoczko, L. Stryer. (2002) "Triacylglycerols Are Highly Concentrated Energy Stores". In: Biochemistry. (5th edition). [On-line]. Available: https://www.ncbi.nlm.nih.gov/books/NBK22369/ [Jun18,2017]

[5] C. P. Day, S. Saksena. "Non-alcoholic steatohepatitis: Definitions and pathogenesis". Journal of Gastroenterology and Hepatology. vol.17, pp. S377–84, 2002.

[6] P. A. Kern, M. Saghizadeh, J. M. Ong, R. J. Bosch, R. Deem, R. B. Simsolo. "The expression of tumor necrosis factor in human adipose tissue. Regulation by obesity, weight loss, and relationship to

lipoprotein lipase". The Journal of Clinical Investigation. vol.95, pp. 2111–9, 1995.

[7] M. H. Fonseca-Alaniz, J. Takada, M. I. C. Alonso-Vale, F. B. Lima."Adipose tissue as an endocrine organ: from theory to practice". Journal de Pediatria (Rio J). vol.83, pp. S192–203, 2007.

[8] A. Ayala, M. F. Munoz, S. Arguelles. "Lipid peroxidation: Production, metabolism, and signaling mechanisms of malondialdehyde and 4-hydroxy-2-nonenal". Oxidative Medicine and Cellular Longevity. vol.2014, pp.1–31, 2014.

[9] R. Volinsky, P. K. J. Kinnunen. "Oxidized phosphatidylcholines in membrane-level cellular signaling: From biophysics to physiology and molecular pathology". Federation of European BBiochemical Society Journal. vol.280, pp. 2806–16, 2013.

[10] P. K. J. Kinnunen, K. Kaarniranta, A. K. Mahalka. "Protein-oxidized phospholipid interactions in cellular signaling for cell death: From biophysics to clinical correlations". Biochimica et Biophysica Acta. vol. 1818, pp.2446 - 55, 2012.

[11] A. Reis, C. M. Spickett. "Chemistry of phospholipid oxidation". Biochimica et Biophysica Acta. vol.1818, pp. 2374–87, 2012.

[12] S. Li, H-Y. Tan, N. Wang, Z-J. Zhang, L. Lao, C-W. Wong, et al. "The Role of Oxidative Stress and Antioxidants in Liver Diseases". International Journal of Molecular Sciences. vol.16, pp. 26087–124, 2015.

[13] A. R. Abdullah, N. A. Bakhari, H. Osman. "Study on the Relationship of the Phenolic, Flavonoid and Tannin Content to the Antioxidant Activity of Garcinia Atroviridis". Universal Journal of Applied Science. vol.1, pp. 95–100, 2013.

[14] H. A. Jung, B. N. Su, W. J. Keller, R. G. Mehta, A. D. Kinghorn. "Antioxidant xanthones from the pericarp of Garcinia mangostana (Mangosteen)". Journal of Agricultural and Food Chemistry. vol. 54, pp. 2077–82, 2006.

[15] I. Nursakinah, H. A. Zulkhairi, M. Norhafizah, B. Hasnah, S. Zamree, S. I. Farrah, et al. "Nutritional content and in vitro antioxidant potential of garcinia atroviridis (asam gelugor) leaves and fruits". Malaysian Journal of Nutrition. vol. 18, pp. 363–71, 2012.

[16] M. M. Mackeen, A. M. Ali, N. H. Lajis, K. Kawazu, Z. Hassan, M. Amran, et al. "Antimicrobial, antioxidant, antitumour-promoting and cytotoxic activities of different plant part extracts of Garcinia atroviridis Griff. ex T. Anders". Journal of Ethnopharmacology. vol. 72, pp.395–402, 2000.

[17] S. Syukur, Syafrizayanti, S. Zulaiha, M. Ismet, E. Fachrial. "Virgin Coconut Oil Increase High Density Lipoprotein (LDL), Lower Triglyceride And Fatty Acids Profile (C6-C18) In Blood Serum of Mus

musculus". Research Journal of Pharmaceutical, Biological and Chemical Sciences. vol.8, pp.1077–81, 2017.

[18] W. C. Stallings, J. F. Blount, P. A. Srere, J. P. Glusker. "Structural studies of hydroxycitrates and their relevance to certain enzymatic mechanisms". Archives of Biochemistry and Biophysics. vol.193, pp.431–48, 1979.

[19] A. C. Sullivan, M. Singh, P. A. Srere, J. P. Glusker. "Reactivity and Inhibitor Potential of Hydroxycitrate Isomers with Citrate Synthase , Citrate Lyase , and ATP Citrate Lyase". The Journal of Biological Chemistry. vol. 252, pp.7583–90, 1977.

[20] R. D. Mattes, L. Bormann. "Effects of (-)-hydroxycitric acid on appetitive variables". Physiology and Behaviour. vol. 71, pp. 87–94, 2000.

[21] I-S. Cheng, S-W. Huang, H-C. Lu, C-L. Wu, Y-C. Chu, S-D. Lee, et al. "Oral hydroxycitrate supplementation enhances glycogen synthesis in exercised human skeletal muscle". British Journal of Nutrition. vol. 107, pp. 1048–55, 2012.

[22] A. Kondo, Y. Muranaka, I. Ohta, K. Notsu, M. Manabe, K. Kotani, et al. "Relationship between Triglyceride Concentrations and LDL Size Evaluated by Malondialdehyde- modified LDL". Clinical Chemistry. vol. 47, pp. 893–900, 2001.

[23] C.J.R.E. Lumbantobing, E. Yerizel, S. Syukur, E. Purwati. "Decreased of Levels of Triglyceride in Subjects Drinking Garcinia atroviridis Leaf Tea from Sijunjung - West Sumatra , Indonesia". American Scientific Research Journal for Engineering Technology, and Sciences.vol. 33, pp. 296–304, 2017.

[24] P. Williams, M. Ongsakul, J. Proudfoot, K. Croft, L. Beilin. "Mangostin Inhibits the Oxidative Modification of Human Low Density Lipoprotein". Free Radical Research. vol. 23, pp. 175–84, 1995.

[25.] F. Nielsen, B. B. Mikkelsen, J. B. Nielsen, H. R. Andersen, P. Grandjean. "Plasma malondialdehyde as biomarker for oxidative stress : reference interval and effects of life-style factors". Clinical Chemistry. vol. 43, pp. 1209–14, 1997.