Functional Foods in Health and Disease 2012, 2(1):1-10

Review **Open Access**

Therapeutic Application of Diacylglycerol Oil for Obesity: Serotonin Hypothesis

Hidekatsu Yanai[1,2*], Hiroshi Yoshida[3], Yuji Hirowatari[4], Norio Tada[5]

[1]Department of Internal Medicine and [2]Clinical Research Center, National Center for Global Health and Medicne Kohnodai Hospital, Ichikawa, Chiba, Japan; [3]Department of Laboratory Medicine, Jikei University School of Medicine, Kashiwa, Chiba, Japan; [4]Bioscience Division, TOSOH Corporation, Ayase, Kanagawa, Japan; [5]Internal Medicine of Metabolism and Nutrition, Jikei University Graduate School of Medicine, Kashiwa, Chiba, Japan

Corresponding author: Hidekatsu Yanai, MD, PhD, FACP, Department of Internal Medicine, National Center for Global Health and Medicine Kohnodai Hospital, 1-7-1 Kohnodai, Chiba 272-8516, Japan

Submission date: November 8, 2011; Acceptance date: December 5, 2011; Publication date: January 3, 2012

ABSTRACT:

Characteristics for the serum lipid abnormalities in the obesity/metabolic syndrome are elevated fasting, postprandial triglyceride (TG), and decreased high-density lipoprotein-cholesterol (HDL-C). Diacylglycerol (DAG) oil ingestion has been reported to ameliorate postprandial hyperlipidemia and prevent obesity by increasing energy expenditure, due to the intestinal physiochemical dynamics that differ from triacylglycerol (TAG). Our study demonstrated that DAG suppresses postprandial increase in TG-rich lipoprotein, very low-density lipoprotein (VLDL), and insulin, as compared with TAG in young, healthy individuals. Interestingly, our study also presented that DAG significantly increases plasma serotonin, which is mostly present in the intestine, and mediates thermogenesis, proposing a possible mechanism for a postprandial increase in energy expenditure by DAG. Our other study demonstrated that DAG suppresses postprandial increase in TG, VLDL-C, and remnant-like particle-cholesterol, in comparison with TAG in an apolipoprotein C-II deficient subject, suggesting that DAG suppresses postprandial TG-rich lipoprotein independently of lipoprotein lipase. Further, to understand the molecular mechanisms for DAG-mediated increase in serotonin and energy expenditure, we studied the effects of 1-monoacylglycerol and

2-monoacylglycerol, distinct digestive products of DAG and TAG, respectively, on serotonin release from the Caco-2 cells, the human intestinal cell line. We also studied effects of 1- and 2-monoacylglycerol, and serotonin on the expression of mRNA associated with β-oxidation, fatty acids metabolism, and thermogenesis, in the Caco-2 cells. 1-monoacylglycerol significantly increased serotonin release from the Caco-2 cells, compared with 2-monoacylglycerol by approximately 40%. The expression of mRNA of acyl-CoA oxidase (ACO), fatty acid translocase (FAT), and uncoupling protein-2 (UCP-2), was significantly higher in 1-MOG-treated Caco-2 cells, than 2-MOG-treated cells. The expression of mRNA of ACO, medium-chain acyl-CoA dehydrogenase, FAT, and UCP-2, was significantly elevated in serotonin-treated Caco-2 cells, compared to cells incubated without serotonin. In conclusion, our clinical and in vitro studies suggested a possible therapeutic application of DAG for obesity, and obesity-related metabolic disorders.

Key words: Diacylglycerol, intestine, obesity, serotonin, thermogenesis