Regular article

日本食品化学学会誌、Vol. 24(1), 16-24(2017)
Japanese Journal of Food Chemistry and Safety (JJFCS)

# Hexane extract of raw ginger enhances adipocyte differentiation through its PPARγ ligand activity on 3T3-L1 preadipocytes

(Received November 7, 2016)
(Accepted December 27, 2016)

Hideaki Kaneoka [a, b, ※], Suguru Ito [a, b, c], Yuko Araki-Hashikawa [a, c], Takeo Yano [b], Katsuzumi Okumura [d], Norihiro Nishimura [e], Kazuhiro Kagotani [a, c]

a) Tsuji H&B Science Laboratory, Mie University
b) Graduate School of Regional Innovation Studies, Mie University
c) Tsuji Oil Mills Co., Ltd.
d) Graduate School of Bioresources, Mie University
e) Graduate School of Medicine, Mie University

## Abstract

Ginger has been reported to show many health enhancement effects. We prepared a hexane extract of raw ginger (HRG) under low temperature, and examined its anti-obesity effects using 3T3-L1 cells. HRG promoted adipocyte differentiation in a dose-dependent manner and enhanced the expression levels of adipocyte-specific genes, such as *adiponectin* and *Glut4*. HRG also exhibited peroxisome proliferator-activated receptor γ ligand activity, similar to antidiabetic drug thiazolidinediones, which promoted adipocyte differentiation and increased small adipocytes. In addition, HRG showed a tendency to suppress the action of tumor necrosis factor-α, which causes insulin resistance by downregulating the expression of adipocyte-specific genes. These findings suggest that HRG would be utilized as a functional food material for the prevention of obesity and related diseases by increasing small adipocytes.

Keywords : ginger, adipocyte, peroxisome proliferator-activated receptor γ, thiazolidinediones

## I Introduction

Ginger (*Zingiber officinale*) is used as a spice and natural medicine, and its extracts are utilized worldwide as nutritional supplements and food additives such as flavorings. Studies on the physiological functions of food materials have been conducted in recent years, and ginger is a good candidate for a functional food material because it is easily harvested and consumed in many countries. It has been reported that ginger components and extracts show antioxidant, anti-inflammatory, antitumor, and anti-obesity effects[1-8]. Thus, in addition to existing ginger-related food products, the development of various types of novel ginger food materials with functional properties can be expected.

Among the above-described effects of ginger, its effect on obesity appears to be an effective and beneficial way to prevent diabetes. Obesity is a state of excess adipose tissue mass. It is a worldwide problem and represents a major risk factor for type 2 diabetes. Adipocytes were originally thought to be required for lipid storage only, but are now recognized as endocrine cells that control energy homeostasis[9, 10]. In the non-obese state, small adipocytes secrete adiponectin, a cytokine that enhances insulin sensitivity. However, tumor necrosis factor (TNF)-α and plasminogen activator inhibitor (PAI)-1, which cause insulin resistance and lead to type 2 diabetes, are secreted by large adipocytes in the obese state[9-11]. Therefore, efforts to increase small adipocytes will form one approach toward the prevention and improvement of diabetes.

Activation of peroxisome proliferator-activated receptor (PPAR) γ can be used as an indicator for differentiation

Corresponding author: Katsuzumi Okumura, Graduate School of Bioresources, Mie University, 1577 Kurimamachiya-cho, Tsu, 514-8507, Japan
※ ; Present position: Toasu Co., Ltd.