

## Cocoa Polyphenol-Rich Extract Enhances the Expression Levels of PPAR- $\gamma$ in the Skeletal Muscle and Adipose Tissue of Obese-Diabetic Rats Fed a High-Fat Diet

<sup>1</sup>Farhana Aminuddin, <sup>1</sup>Faisal Ali, <sup>1,2</sup>Amin Ismail, <sup>3</sup>Chong Pei Pei and <sup>4</sup>Muhajir Hamid

<sup>1</sup>Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

<sup>2</sup>Research Center of Nutrition and Non-Communicable Diseases, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

<sup>3</sup>Department of Biomedical Sciences, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

<sup>4</sup>Department of Microbiology, Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

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#### Corresponding Author:

Amin Ismail,

Department of Nutrition and Dietetics,  
Faculty of Medicine and Health

Sciences, Universiti Putra Malaysia,

43400 UPM Serdang, Selangor,

Malaysia

Tel: + 60389472435

Fax: +60389426769

### ABSTRACT

Cocoa, the fruit of *Theobroma cacao* plant is traditionally used in the folk medicine as a pharmaceutical for blood pressure reduction and cardiovascular diseases prevention. The nuclear receptor peroxisome proliferator-activated receptor gamma (PPAR- $\gamma$ ) is widely known to improve insulin sensitivity and is thereby being used as a major drug target for the treatment of type 2 diabetes mellitus. The present study investigated the anti-diabetic/anti-obesity effects of cocoa polyphenol-rich extract (CoPE) using obese-diabetic rats (Sprague Dawley rats). Sprague Dawley rats received either normal diet, high-fat diet or high-fat diet with additional cocoa polyphenols for 8 weeks. After the end of the treatment, body weight, plasma glucose and insulin were measured. Furthermore, mRNA and protein levels of PPAR $\gamma$  were measured in skeletal muscle and white adipose tissue. Compared to the high-fat diet group, increases in body weight, plasma glucose and insulin were significantly suppressed for CoPE-treated groups. Furthermore, compared to the high-fat diet group, the PPAR $\gamma$  mRNA level was significantly higher in both skeletal muscle and white adipose tissue for CoPE groups. Protein expression of PPAR $\gamma$  in CoPE groups was also significantly higher compared to the high-fat diet group. In conclusion, the anti-diabetic mechanism of actions of CoPE along with metformin hypoglycemic drug is partially attributed to increase expression of PPAR $\gamma$  in skeletal muscle and adipose tissue. These results suggest that CoPE could be a useful phytomedicine agent for alleviating insulin resistance.

**Key words:** Cocoa polyphenol extract, insulin resistance, phytopharmacological actions, metformin, PPAR- $\gamma$  gene expression, PPAR- $\gamma$  protein expression level

### INTRODUCTION

Diabetes mellitus is a metabolic disorder with multiple causes and etiology that is characterized by hyperglycemia and insulin resistance. Type 2 diabetes is globally increased and comprises over 90% of diabetes cases (Gershell, 2005; Wild *et al.*, 2004). Diabetic patients frequently demand to use natural medicines with anti-diabetic properties due to the side

effects associated with the use of insulin and conventional drugs. Utilization of medicinal plants for the management and treatment of diabetes mellitus dates back to the Ebers papyrus from approximately 1550 B.C (Holman and Turner, 1991; Rao *et al.*, 1997).

Scientific research has proven the efficacy of many of medicinal plants, some of which are remarkably effective (Grover *et al.*, 2002). *Theobroma cacao* is a small evergreen