Immature persimmon (*Diospyros kaki* Thunb.) extract suppressed obesity by regulating lipid metabolism in 3T3-L1 cells

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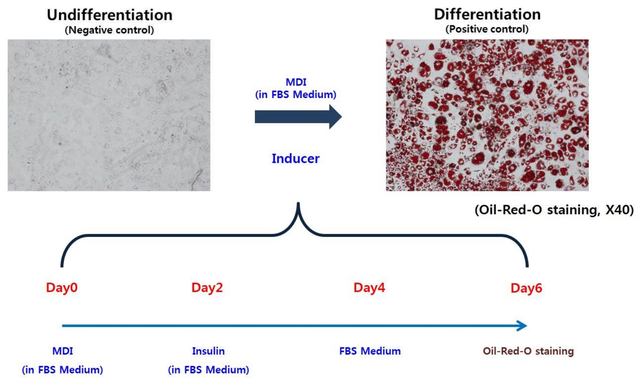
Abstract

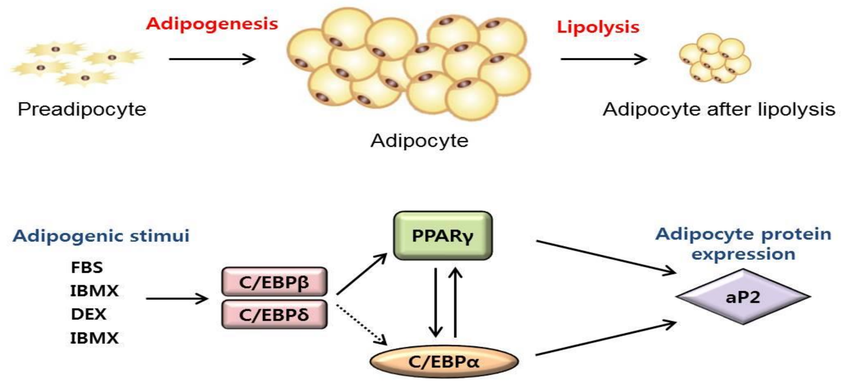
Our previous studies reported that 50% ethanol extract of **immature persimmon** (***Diospyros kaki* Thunb**.) suppressed body weight gain, adipose tissue weight, and serum triglyceride levels in a high-fat-diet induced mouse model. This study was performed to investigate whether the 50% ethanol extract of *Diospyros kaki* Thunb. could regulate **lipid metabolism** by identifying its mechanism in 3T3-L1 cells. As a result, whereas did not influence on cell viability and toxicity, a significant decrease in the accumulation of lipid droplets was observed in a concentration-dependent manner during adipogenesis (adipogenic differentiation). Also, consistent with animal studies, *Diospyros kaki* Thunb. extract (DKE) dose-dependently suppressed **peroxisome proliferator-activated receptor γ** and **CCAAT/enhancer-binding proteins** that induce adipocyte differentiation in 3T3-L1 pre-adipocytes. In addition, it increased phosphorylated **AMP-activated protein kinase** (AMPK) and **acetyl-CoA carboxylase** (ACC) in a dose-dependent manner in 3T3-L1 cells. In conclusion, **these results present that immature persimmon (*Diospyros kaki* Thunb.) may have potential as a natural agent for preventing and/or treating obesity.**

Introduction & Methods

Figure 1. ***Diospyros kaki***

- **Scientific name**: *Diospyros kaki*
- **Family name**: Ebenaceae
- **Distrubution**: Korea, China, Japan
- **Phytochemical**: Carotenoids, Phenolic acid, Tannis, Flavonoids, Proanthocyanidins
- **Research subject**: Jeju immature persimmon ethanol extract





Results

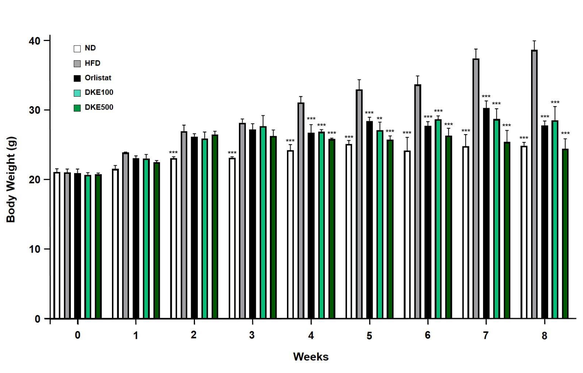


Figure 2. Effect of DKE in HFD-fed C57BL/6 mice for the period of obesity induction. Values are expressed as mean ± SD. **p < 0.01 and ***p < 0.001 compared with the HFD group.

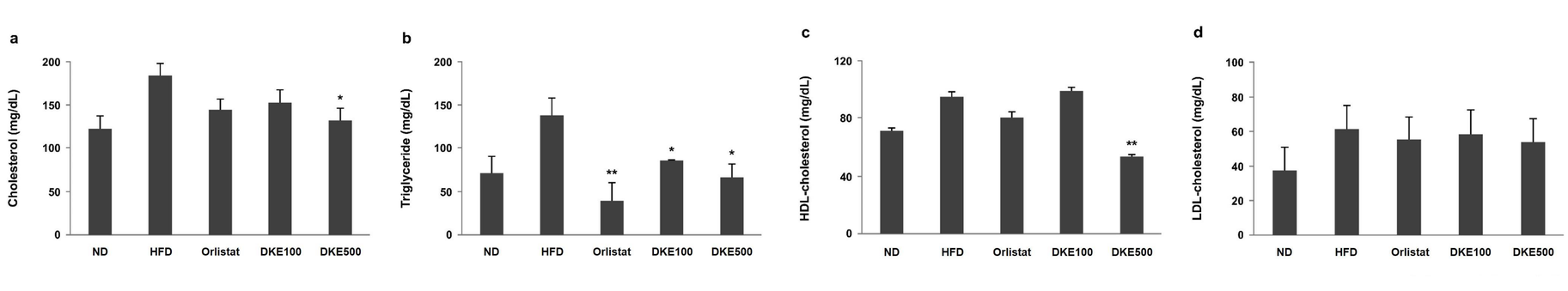


Figure 3. Effect of DKE on blood biochemistry parameters in HFD-fed obese mice. Lipid biochemical analysis was conducted on the serum isolated from each experimental animal. The levels of (a) total cholesterol, (b) triglyceride, (c) HDL-C, and (d) LDL-C were evaluated. Orlistat, a drug designed for the treatment of obesity, was a positive control. Values are expressed as mean ± SD. *p < 0.05 and **p < 0.01 compared with the HFD group. ND, normal diet; HFD, high-fat diet; DKE100, *Diospyros kaki* extract 100 mg/kg; DKE500, D. kaki extract 500 mg/kg (n = 5 mice per group).

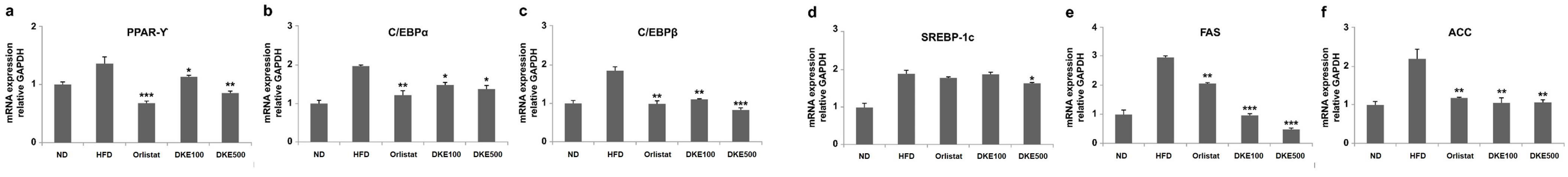


Figure 4. Effect of DKE on the gene mRNA expression in the liver of HFD-fed obese mice. The gene expression patterns in the liver tissues extracted from each experimental animal were analyzed through real-time PCR amplification. The gene mRNA expressions in the liver of (a) PPARγ, (b) C/EBPα, (c) C/EBPβ, (d) SREBP-1c, (e) FAS, and (f) ACC were investigated. Orlistat, a drug designed for the treatment of obesity, was a positive control. Values are expressed as mean ± SD. *p < 0.05, **p < 0.01, and ***p < 0.001 compared with the HFD group. ND, normal diet; HFD, high-fat diet; DKE100, Diospyros kaki extract 100 mg/kg; DKE500, D. kaki extract 500 mg/kg (n = 5 mice per group)..

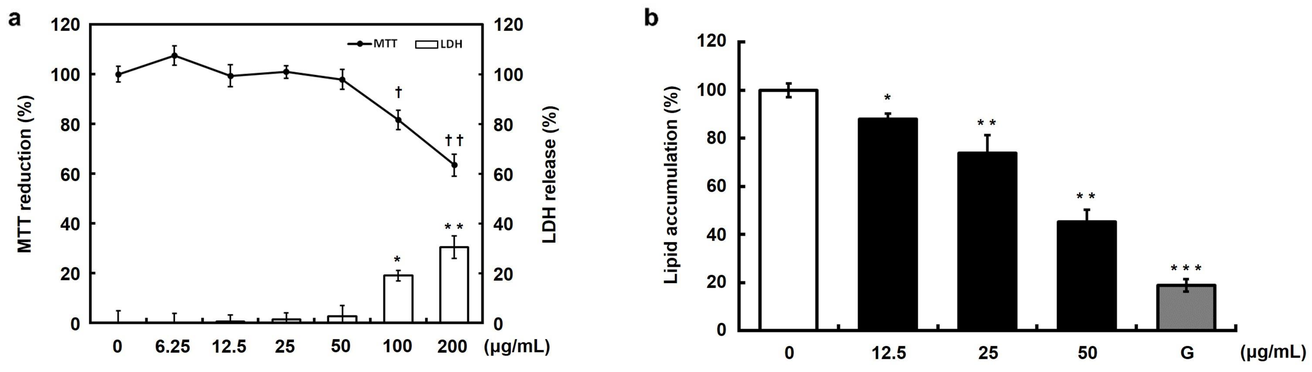


Figure 5. Effect of DKE on cell viability (a) and lipid accumulation (b) in 3T3-L1 cells. 3T3-L1 cells were differentiated in MDI differentiation medium with indicated concentrations of compounds for 6 days. Differentiated adipocytes were stained with Oil-Red-O. Lipid accumulation was assessed by the quantification of OD_{520}. Data shown are presented as the means±S.D. of three independent experiments. (a) cell viability and cytotoxicity (b) lipid accumulation. *P<0.05, **P<0.01, ***P<0.001, †P<0.05 and ††P<0.01 compared to untreated DKE G; Genistein.

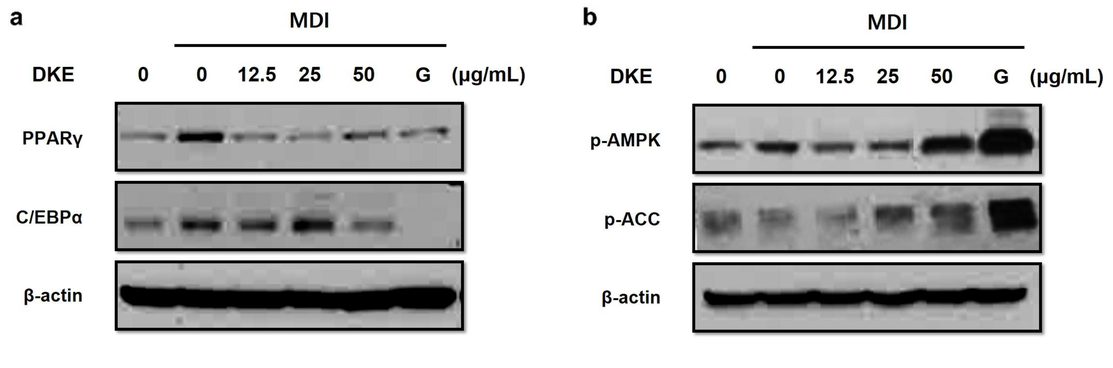


Figure 6. Effect of DKE on expression of adipocyte differentiation and energy metabolism-related proteins in 3T3-L1 cells. 3T3-L1 cells were differentiated in MDI differentiation medium with indicated concentrations of DKE. Protein extracts are immunoblotted with specific antibody that recognizes PPARγ, C/EBPα, p-AMPK, p-ACC and β-actin. The results are representative of three independent experiments. G; Genistein.

Conclusion

.This study was performed to investigate whether the 50% ethanol extract of *Diospyros kaki* Thunb. could regulate lipid metabolism by identifying its mechanism in 3T3-L1 cells. Taken together, immature persimmon (*Diospyros kaki* Thunb.) may have potential as a natural agent for preventing and/or treating obesity.

References

1. Devlin *et al.* (2000) *Am J Psychiatry. 157*:854-866
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3. Madsen *et al*. (2017) *Eur Heart J.* 38:2478-2486