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Pancreatic lipase inhibition of strictinin isolated from Pu'er tea (*Camellia sinensis*) and its anti-obesity effects in C57BL6 mice ☆

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Highlights

- Effective inhibition of strictinin on pancreatic lipase *in vitro*.
- Reducing the blood triglyceride level of mice via administration of strictinin.
- Lowering fat accumulation in mice fed with high-fat diet by supplying strictinin.

Abstract

Strictinin isolated from Pu'er tea was demonstrated to inhibit pancreatic lipase *in vitro*. In an olive oil tolerance test, the administration of strictinin (100 mg/kg) significantly reduced the blood triglyceride level and increased the fecal oil content of C57BL6 mice. In a long-term animal study, the body weight gained via high-fat diet was significantly reduced in the mice supplemented with strictinin of 130 mg/kg. Further analysis showed that weight of epididymal fat, but not that of liver or muscle, increased in mice fed with high-fat diet, and the increase of fat was reduced in the mice supplemented with strictinin. Correspondingly, sizes of adipocytes in epididymis were substantially enlarged in mice fed with high-fat diet, and the enlargement of adipocytes was decreased when strictinin was supplemented. Levels of blood triglyceride, cholesterol and glucose were elevated in mice fed with high-fat diet, and these elevated levels were reduced when strictinin was supplemented.

Graphical abstract

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Introduction

Tea is one kind of beverages widely consumed around the world, and its major soluble compounds, polyphenols have been demonstrated to provide a variety of beneficial functions to human health (Haslam, 2003; Higdon and Frei, 2003; Lo et al., 2014; Yukihiko, 2012). Pu'er tea is produced from young leaves of *Camellia sinensis* var. *assamica* via a unique process termed post-fermentation, in which microorganisms seem to play a key role during the chemical conversion for its specialized aroma and taste (Lee and Hou, 2013; Maeda-Yamamoto et al., 2004). Besides its distinct aroma and taste, Pu'er tea is assumed to possess a wide range of therapeutic effects, such as anti-obesity, anti-mutagenic, antiviral, and antimicrobial activities as well as hyperlipidemia, hypoglycemic and free radical scavenging effects (Du et al., 2012; Hou et al., 2009; Qian et al., 2008; Saha et al., 2010; Su et al., 2012; Wang et al., 2008; Zhao et al., 2011). Empirically, Pu'er teas produced from wild trees are perceived to possess better biological effects than those produced from cultivated shrubs, particularly for the healing effects against viral and microbial infections as well as the anti-obesity and laxative effects on defecation (Chen et al., 2015; Hsieh et al., 2016; Li et al., 2014; Pei et al., 2011; Wu et al., 2007).

Strictinin, a hydrolysable tannin belonging to the family of ellagitannin, is frequently identified as a minor phenolic compound in various teas in comparison with the abundant catechins (Yagi et al., 2009; Zhao et al., 2011). Nevertheless, instead of catechins, strictinin was identified as the major phenolic compound in raw Pu'er teas produced from leaves and buds of wild trees (Chen et al., 2015). Interestingly, the content of strictinin in leaves of wild trees was found significantly higher than that in leaves of cultivated shrubs. Several therapeutic activities of strictinin have been reported, such as antiviral, antibacterial, antiallergic, immunostimulator, and laxative effects in the past two decades (Chen et al., 2015; Hsieh et al., 2016; Monobe et al., 2008; Saha et al., 2010; Tachibana et al., 2001). Moreover, strictinin was suggested to be an adequate ingredient for the supplementation in food, cosmetics and beverages (Tsuji, Yamamoto, Kawamoto, & Tachibana, 2003).

Excessive food consumption prevails over modern diets, and thus more and more people accumulate excess body fat and suffer in overweight. At present, obesity becomes a major public health problem and is commonly associated with the risk of illness, such as hypertension, heart disease and diabetes. Reasonably, prevention of fat absorption from diets is an effective way for the treatment of diet-induced obesity. As direct uptake of dietary triglycerides is unworkable in the digestion system, pancreatic lipase is secreted into small intestine and hydrolyzes triglycerides to monoglycerides and free fatty acids prior to absorption by epithelial cells in the small intestine. In this aspect, orlistat, an authorized anti-obesity drug, is taken to prevent absorption of fat in diets by acting as an inhibitor of pancreatic lipase in small intestine (Zhi, Melia, Eggers, Joly, & Patel, 1995).

We wondered if the empirical anti-obesity effects of Pu'er tea might be resulted from the prevention of fat absorption from diets by inhibiting pancreatic lipase in a manner similar to orlistat. To examine this possibility, raw and ripen Pu'er teas as well as three major compounds, caffeine, strictinin and (−)-epigallocatechin gallate (EGCG) in raw Pu'er tea were subjected to an *in vitro* assay of pancreatic lipase inhibition. The results suggested that strictinin might be an adequate inhibitor of pancreatic lipase. Subsequently, two animal models, olive oil tolerance test and reduction of fat accumulation in high-fat diet, were executed to evaluate the anti-obesity effects of strictinin.

Section snippets

Chemicals and materials

Ethyl acetate, butanol and methanol were purchased from ECHO Chemical, Co. (Taichung, Taiwan). High performance liquid chromatography (HPLC) grade acetonitrile and methanol were purchased from Fisher Scientific (Fair Lawn, NJ, USA). Acetic acid (99.7%) was obtained from J.T. Baker (Mallinckrodt Baker, Inc., Phillipsburg, NJ, USA). Double-distilled water was afforded by a Millipore clear water purification system (Direct-Q, Millipore, Billerica, MA, USA). Porcine pancreatic lipase Type II was ...

Isolation of strictinin from raw Pu'er tea

Infusion of raw Pu'er tea produced from young leaves of wild trees was analyzed on a HPLC system and found to contain abundant strictinin (Fig. 1A). In accord with an earlier report (Chen et al., 2015), strictinin and EGCG were detected as two abundant phenolic compounds in the raw Pu'er tea but not in ripen Pu'er tea that contained low contents of phenolic compounds (Fig. 1B). Strictinin was isolated to homogeneity from the raw Pu'er tea, and its purity of approximately 95% was examined in the ...

Discussion

Empirically, drinking a variety of teas, particularly Pu'er tea, is regarded to result in an anti-obesity effect (Lee and Hou, 2013; Yukihiko, 2012). It has been shown that extracts of white and green teas, particularly those fractions enriched in strictinin, possessed inhibitory potency on pancreatic lipase *in vitro* (Gondoin, Grusso, Stewart, & McDougall, 2010). In this study, we first demonstrated that strictinin isolated from Pu'er tea possessed inhibitory potency on pancreatic lipase *in* ...

Conclusion

Strictinin, a major phenolic compound in Pu'er teas produced from young leaves of wild trees, was demonstrated to possess inhibitory potency on pancreatic lipase *in vitro*. Furthermore, the administration of strictinin was shown to reduce the blood triglyceride level of mice in olive oil tolerance test and to lower fat accumulation in mice fed with high-fat diet in a long-term study. Taken together, strictinin seems to be a major component responsible for the empirical anti-obesity effects of ...

Conflict of interest

The authors have no conflict of interest/financial disclosure. ...

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Chemical constituents and biological properties of Pu-erh tea
2022, Food Research International

Citation Excerpt :
...Liu et al. (2019) reported that polyphenols contributed to the effects of raw Pu-erh tea water extracts (1000 mg/kg BW) for reducing white fat accumulation and increased lipid metabolism in the HFD-induced obese mice (male ICR mice) via up-regulating pAMPK, inhibiting FAS and reducing IL-6 levels. Chen, Wang et al. (2018) observed that strictinin (100 mg/kg, extracted from raw Pu-erh tea) reduced fat absorption and increased the oil content in fecal excretion of olive oil (5 mL/kg)-fed mice (male C57BL6 mice). Such effects was comparable to the effects of Orlistat (10 mg/kg, an anti-obesity drug)....

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...In addition, strictinin isolated from Pu'er tea showed an inhibitory activity on pancreatic lipase in vitro. Also, strictinin significantly reduced TG and increased fecal oil content in mice in the olive oil tolerance test [108]. Moreover, the processing method has a great influence on the suppressive activity of bioactive compounds in tea to digestive enzymes....

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Effects and mechanisms of tea on obesity ↗
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Chemical profile changes during pile fermentation of Qingzhuan tea affect inhibition of α-amylase and lipase ↗
2020, Scientific Reports

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2020, Journal of Agricultural and Food Chemistry

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Chemical compounds studied in this article: strictinin (PubChem CID: 73330).

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