SciMedCentral

International Journal of Plant Biology & Research

Short Communication

Inhibition of Pancreatic Lipase by Culinary Plant Extracts

Ozkan Danış, Ayse Ogan*, Damla Anbar, Basak Yuce Dursun, Serap Demir and Umit Salan

Department of Chemistry, Marmara University, Turkey

***Corresponding author**

Ayse Ogan, Faculty of Arts and Sciences, Department of Chemistry, Marmara University, Goztepe, Istanbul-34722, Turkey, Tel: +90-216-3485938; Fax: +90-216-3478783; Email: aogan@marmara.edu.tr

Submitted: 16 February 2015

Accepted: 20 April 2015

Published: 24 April 2015

ISSN: 2333-6668

Keywords

- Obesity
- Lipase
- Lipase inhibition
- Anti-obesity plants

Abstract

Obesity is a strong risk factor for various diseases, such as hypertension, arteriosclerosis and diabetes. Therefore, an effective way to prevent obesity is to inhibit fat absorption from intestines. Pancreatic lipase is a key enzyme for lipid absorption. One of the approaches to reduce obesity is treatment with natural products. Many plants have been reported to inhibit lipase activity which is attributable to the presence of secondary metabolites such polyphenols, benzopyrones whose members include flavonoids, saponins, coumarins etc. are active inhibitors of pancreatic lipase. In our study using porcine pancreatic lipase, a series of plants were screened for their pancreatic lipase inhibitory activities. According to the results; green apple, green tea and avocado extracts had the highest antilipase activities. These plants based diets may be involved in weight control programs.

ABBREVIATIONS

PL: Pancreatic Lipase

INTRODUCTION

Obesity results from complex interactions of genetic, behavioral and environmental factors correlating with economic, social status and life styles [1-2]. Primary causes of obesity are insufficient exercise and un healthy **food** choices [3-4]. Only a few substances such as or list at (tetrahydrolipstatin) interact directly with lipases [5-7] but, causes unpleasant side effects on gastrointestinal system and kidneys [8]. A considerable interest has recently aroused to the potential of natural products for their health promotion and disease prevention [9-10]. Their action on multiple molecular targets, thus offers advantages over treatments with single chemicals. These products contain dietary phytochemicals with high potential their anti-obesity effects are mediated by regulation of various pathways, including lipid absorption [11-13].

Thus, the objective of this study was to examine the crude methanol extracts of 23 different parts (seeds, fruits, leaves, roots, stem, bark and whole part) of some culinary, herbal and aquatic plants assumed to induce body weight reduction in Turkish folk medicine for their pancreatic lipase (PL) inhibitory activities.

MATERIALS AND METHODS

Sampling of plant materials

The plant materials of the present study were gathered from local markets in İstanbul,

Extraction of plants

To 0.5 g of dried and ground herbs and 2.0 g of ground fresh fruits and vegetables, 8 mL of water : methanol (1:1) mixture was added, treated with ultrasound for 10 min and macerated at room temperature for 24 h. The macerate was then treated with ultrasound for 10 min and the supernatant was separated by centrifugation (10 min, 3000 rpm). After filtration of the supernatant under reduced pressure, the filtrate was stored at -20 °C [16]. For avoiding lipase denaturation, extracts exhibiting low and high pH values were neutralized.

Inhibitory activity assay

The ability of the compounds to inhibit porcine pancreatic lipase was evaluated using previously reported methods with a minor modification [17]. Briefly, an enzyme buffer was prepared by the addition of 30 µL (10 units) of a solution of porcine pancreatic lipase (Sigma, St. Louis, MO) in 10 mM MOPS (morpholine propane sulphonic acid), and 1 mM EDTA, pH 6.8 to 850 µL of Tris buffer (100 Mm Tris-HCl and 5 mM $CaCl_2$, pH 7.0) and or list at (Roche, Switzerland)as a positive control with a concentration of 0.01 µg/mL was mixed with 880 µL of enzyme buffer, and incubated for 15 min at 37 °C. Then, 20 µL of the substrate solution (10 m M*p*-nitrophenylbutyrate in dimethyl formamide) was added and the enzymatic reaction was allowed to proceed for 15 min at 37°C. Pancreatic lipase activity was determined by measuring the hydrolysis of *p*-nitrophenylbutyrateto *p*-nitrophenol at 405 nm using the Helios Zeta UV-Vis spectrometer (Thermo Sci., Waltham, MA, USA). Inhibition of lipase activity was expressed as the percentage

decrease in the optical density when porcine pancreatic lipase was incubated with the test compound. All samples were assayed in triplicate and an inhibitor blank was prepared for each sample.

RESULTS AND DISCUSSION

Retardation of nutrient absorption and digestion may be used as an approach to manage obesity and related diseases. The methanol extracts of 23 culinary plants assumed to have weight reducing effect were screened for their PL inhibitory activities. The results were tabulated to show the list of plants that display 40% and over 40% inhibitory activity (Tables 1 & 2). Evaluating the results, seven extracts can be regarded as poor PL inhibitors. Among the extracts exhibiting over 40% inhibition, namely avocado (*Persea americano*) displayed 87%, green tea (*Camellia simensis*); 85% and apple (green skin; Granny Smith variety (*Malusdomestica x M.sylvestris*) 99% inhibitory activities, respectively. As there is a likelihood that the inhibitory effect observed could be due to the acidic plant extracts having pH values below 4.0, such as lemon, pineapple, grapefruit although had high inhibitory effects were excluded from the group. When the pH of these extracts was adjusted to 6-7 inhibitory activities decreased drastically. Lipase inhibitory activity of green tea is thoroughly examined in many reports [18,19]. Green tea is a rich source of polyphenols, Gondoin et al. [20] reported EC_{50} value as 25 µg GAE/ml for green tea hot water infusions which is consistent with our findings where as black tea displayed lower inhibition than green tea. In a study of Bose et al. [21] it was shown that the major flavanol(-)-epigallocatechin-3-gallate which is the most abundant polyphenol in green tea had decreased mesenteric fat weight of high fat-induced obesity mices. Avocado was also shown as a potent inhibitor of lipase as shown in a study of Ado et al. [22] and Rodriquez-Carpenaet al.[23], phenolic substances are widely distributed in flesh and seed of avocado,pyrogallol and protocatechuic acid are the main polyphenol contents of avocado. Apple polyphenol extracts are also potent inhibitors of PL[23]. Pectin extracted from apple

Table 1: Plant extracts that showed below 40% inhibitory activity.

Common name	Scientific name	Part used	Percentage of inhibition (%)
Apple	**Malus x** domestica,	FR	31
Cabbage	**Brassica***oleracea* var. *capitata*	WP	39
Cabbage (red)	*Brassica oleracea* var. *capitata f. rubra*	WP	40
Ginger	*Zingiber officinale*	R	36
Olive	*Olea europaea*	L	37
Red Apple	*Malus domestica*	FR	31
Senna	*Senna*	L	18
Orlistat (0.01µg/mL)	Tetrahydrolipstatin		100

*Plant parts: FR: Fruits, L: Leaves, R: Root, WP: Whole Plant. Results are presented as mean. Mean was taken as the avarage of three readings of each experiment.

Table 2: Plant extracts that showed over 40% inhibitory activity.

Common name	Scientific name	Part used	Percentage of inhibition (%)
Arctichoke	*Cynara cardunculus var. scolymus*	WP	43
Avocado	*Persea americana*	FR	92
Avocado	*Persea americana*	S	57
Black tea	*Camellia sinensis*	L	68
Brussels sprout	*Brassica oleracea*	WP	49
Chard	*Beta vulgaris* subsp. *cicla*	WP	61
Cherry	*Prunus avium*	ST	67
Cinnamon	*Cinnamomum zeylanicum Nees*	B	73
Corn tassel	*Stylus maydis*	WP	64
Grape	*Vitaceae vitis*	S	81
Grapefruit	*Citrus paradisi*	FR	55
Green apple (Granny Smith)	*Malus domestica*	FR	99
Green coffee	*Coffea arabica*	S	45
Green tea	*Camellia sinensis*	L	85
Kiwi	*Actinidia chinensis*	FR	67
Lemon	*Citrus limon*	FR	49
Parsley	*Petroselinum sativum*	WP	59
Pineapple	*Ananas comosus*	FR	57
Rosemary	*Rosmarinus officinalis*	L	58
Shrub	*Ericae vulgaris*	L	57
Orlistat (0.01µg/mL)	Tetrahydrolipstatin		100

*Plant parts: FR: Fruits, L: Leaves, S: Seed, WP: Whole Plant, B: Bark, ST: Stem. Results are presented as mean. Mean was taken as the average of three readings of each experiment.

(*Maluspumila*) showed 94.30% lipase inhibition in a study of Kumar et al. [24]. Oligomericprocyanidins were found as main active components for lipase inhibition [25] and lipase inhibitory activity exhibited by apple peels from different cultivars may be due to their ursenoic acid content [26].

According to our evaluation, a diet supported with avocado, green tea and green apple cultivar "Granny Smith" may help to inhibit lipase and weight control.

CONCLUSION

A diet focusing on avocado, green tea and green apple may reduce body weight and compounds from these plants may be developed as anti-obesity clinical products.

REFERENCES

1. Kopelman PG. Obesity as a medical problem. Nature. 2000; 404: 635-643.
2. Halford JC. Pharmacotherapy for obesity. Appetite. 2006; 46: 6-10.
3. Keith SW, Redden DT, Katzmarzyk PT, Boggiano MM, Hanlon EC, Benca RM, et al. Putative contributors to the secular increase in obesity: exploring the roads less traveled. Int J Obes (Lond). 2006; 30: 1585-1594.
4. Lean MEJ. Management of obesity and overweight. Medicine.2006; 34: 515-520.
5. Ballinger A, Peikin SR. Orlistat: its current status as an anti-obesity drug. Eur J Pharmacol. 2002; 440: 109-117.
6. Hvizdos KM, Markham A. Orlistat: a review of its use in the management of obesity. Drugs. 1999; 58: 743-760.
7. Clapham JC, Arch JR, Tadayyon M. Anti-obesity drugs: a critical review of current therapies and future opportunities. Pharmacol Ther. 2001; 89: 81-121.
8. Filippatos TD, Derdemezis CS, Gazi IF, Nakou ES, Mikhailidis DP, Elisaf MS. Orlistat-associated adverse effects and drug interactions: a critical review. Drug Saf. 2008; 31: 53-65.
9. de la Garza AL, Milagro FI, Boque N, Campión J, Martínez JA. Natural inhibitors of pancreatic lipase as new players in obesity treatment. Planta Med. 2011; 77: 773-785.
10. Birari RB, Bhutani KK. Pancreatic lipase inhibitors from natural sources: unexplored potential. Drug Discov Today. 2007; 12: 879-889.
11. Krzyzanowska J, Czubacka A, Oleszek W. Dietary phytochemicals and human health. Adv Exp Med Biol. 2010; 698: 74-98.
12. Lee EM, Lee SS, Chung BY, Cho JY, Lee IC, Ahn SR, et al. Pancreatic lipase inhibition by C-glycosidic flavones Isolated from Eremochloa ophiuroides. Molecules. 2010; 15: 8251-8259.
13. Krzyzanowska J, Czubacka A, Oleszek W. Dietary phytochemicals and human health. Adv Exp Med Biol. 2010; 698: 74-98.
14. Visioli F, Borsani L, Galli C. Diet and prevention of coronary heart disease: the potential role of phytochemicals. Cardiovasc Res. 2000; 47: 419-425.
15. Visioli F, Bogani P, Grande S, Detopoulou V, Manios Y, Galli C. Local food and cardioprotection: the role of phytochemicals. Forum Nutr. 2006; 59: 116-129.
16. Ahn JH, Liu Q, Lee C, Ahn MJ, Yoo HS, Hwang BY, et al. A new pancreatic lipase inhibitor from Broussonetia kanzinoki. Bioorg Med Chem Lett. 2012; 22: 2760-2763.
17. Slanc P, Doljak B, Kreft S, Lunder M, Janes D, Strukelj B. Screening of selected food and medicinal plant extracts for pancreatic lipase inhibition. Phytother Res. 2009; 23: 874-877.
18. Nakai M, Fukui Y, Asami S, Toyoda-Ono Y, Iwashita T, Shibata H, et al. Inhibitory effects of oolong tea polyphenols on pancreatic lipase in vitro. J Agric Food Chem. 2005; 53: 4593-4598.
19. Wolfram S, Wang Y, Thielecke F. Anti-obesity effects of green tea: from bedside to bench. Mol Nutr Food Res. 2006; 50: 176-187.
20. GondoinA, Grussu D, Stewart D, McDougall GJ. White and green tea polyphenols inhibit pancreatic lipase in vitro. Food Res Int. 2010; 43: 1537-1544.
21. Bose M, Lambert JD, Jihyeung J, Kenneth RR, Shapses SA, Chung SY. The major green tea polyphenol, (-)-epigallocatechin-3-gallate, inhibits obesity, metabolic syndrome and fatty liver disease in high-fat–fed mice. J Nutr. 2008; 138: 1677-1683.
22. Ado MA, Abas F, Mohammed AS, Ghazali HM. Anti- and pro-lipase activity of selected medicinal, herbal and aquatic plants, and structure elucidation of an anti-lipase compound. Molecules. 2013; 18: 14651-14669.
23. Bouayed J, Hoffmann L, Bohn T. Total phenolics, flavonoids, anthocyanins and antioxidant activity following simulated gastro-intestinal digestion and dialysis of apple varieties: Bioaccessibility and potential uptake. Food Chem. 2011; 128: 14-21.
24. Kumar A, Chauhan GS. Extraction and characterization of pectin from apple pomaceand its evaluation as lipase (steapsin) inhibitor. carbohydrate polymers. 2010; 82: 454-459.
25. Sugiyama H, Akazome Y, Shoji T, Yamaguchi A, Yasue M, Kanda T et al. Oligomeric procyanidins in apple polyphenol are main active components for inhibition of pancreatic lipase and triglyceride absorption. J Agric Food Chem.2007; 55: 4604-4609.
26. McGhie TK, Hudault S, Lunken RC, Christeller JT. Apple peels, from seven cultivars, have lipase-inhibitory activity and contain numerous ursenoic acids as identified by LC-ESI-QTOF-HRMS. J Agric Food Chem. 2012; 60: 482-491.

Cite this article

Danış O, Ogan A, Anbar D, Dursun BY, Demir S, et al. (2015) Inhibition of Pancreatic Lipase by Culinary Plant Extracts. Int J Plant Biol Res 3(2): 1038.