In vitro inhibitory effects on pancreatic lipase and α-glucosidase activity by extracts and fractions of *Lavandula angustifolia* L. from Southern Italy

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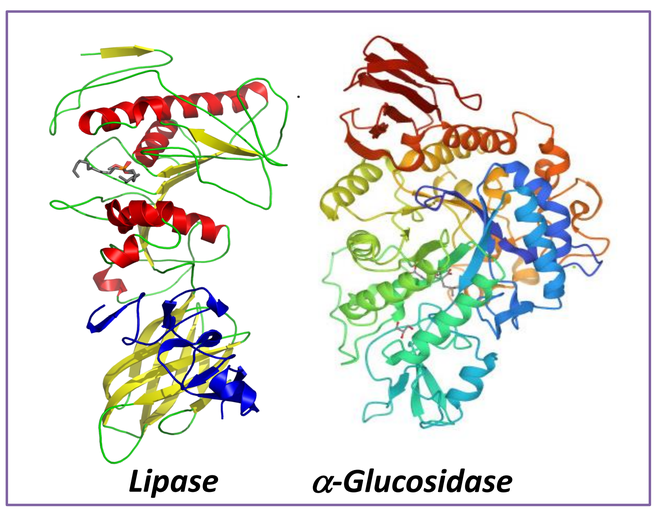
Introduction. *Lavandula angustifolia* is one of the most popular medicinal plants and a rich source of bioactive compounds [1]. Many studies had focused on its essential oil and its use as a sleep aid, calmative, and flavoring agent [2]. This work aimed at investigating the potential role of *L. angustifolia* in the management of metabolic syndrome (MetS) by assessing the inhibitory activity of key enzymes such as lipase and α-glucosidase [3]. MetS is one of the major public-health and clinical challenge worldwide in the wake of urbanization, surplus energy intake, increasing obesity, and sedentary life habits [4].

Materials and methods. The aerial parts of *L. angustifolia* (431.4 g), collected in June 2021 in the "Parco Nazionale del Pollino", Southern Italy, were subjected to exhaustive maceration (1 l, 3 x 72 h) with ethanol as solvent with an extraction yield of 8.72%. The extract was analysed for its total phenol content (TPC) and total flavonoid content (TFC) as previously described [5]. Briefly, TPC was spectrophotometrically assessed by using Folin-Ciocalteu reagent. Absorbance was read at 765 nm using a UV-Vis Jenway 6003 spectrophotometer (Milan, Italy) and TPC was expressed as mg of chlorogenic acid equivalents (CA)/g of plant materials. To analyse TFC, a method based on the formation of a flavonoid-aluminium complex was applied. Absorbance was read at 510 nm and TFC was expressed as mg of quercetin equivalents (QE)/g of plant materials.



After partitionation with *n*-hexane (8 x 200 ml), dichloromethane (8 x 200 ml) and ethyl acetate (8 x 200 ml), total extract and fractions were evaluated for their ability to inhibit α-glucosidase and porcine pancreatic lipase [6]. In the α-glucosidase inhibitory activity test, α-glucosidase (EC 3.2.1.20) was mixed with a maltose solution and *o*-dianisidine (DIAN). Samples at different concentrations were added and left to incubate at 37 °C for 30 min. Then, perchloric acid was added and the mixture was centrifuged. The supernatant was collected and mixed with DIAN and peroxidase/glucose oxidase (PGO) system-colour reagent solution, and left to incubate at 37 °C for 30 min. The absorbance was read at 500 nm.

The activity of lipase (EC 3.1.1.3) was measured using *p*-nitrophenyl octanoate (NPC) as a substrate and orlistat as a positive control. In brief, NPC 5 mM in dimethylsulfoxide solution and an aqueous solution of porcine pancreatic lipase enzyme (1 mg/mL), and Tris-HCl buffer (pH 8.5) were prepared. *L. angustifolia* extract and fractions at concentrations at different concentrations were added and the mixture was incubated at 37°C for 30 min. The absorbance was measured at 405 nm.

Results. *L. angustifolia* ethanol extract, with showed a TPC and TFC of 27.95 mg of CA equivalents/g plant materials and 18.48 mg of QE equivalents/g plant materials, inhibited the tested enzymes activity, in a concentration-dependent manner. Indeed, the extract inhibited α-glucosidase and lipase (IC_{50} of 2.55 and 30.50 μg/ml, respectively) better than the positive control acarbose and orlistat (IC_{50} of 35.51 and 37.12 μg/ml, respectively). After fractionation, the most active fractions were dichloromethane and ethyl acetate fractions with IC_{50} of 17.64 and 102.58 μg/ml, against lipase and α-glucosidase, respectively.

Table 1. Inhibitory activity (IC_{50} μg/mL) of pancreatic lipase by *L. angustifolia* fractions.

Fraction	α-Glucosidase	Lipase
***n*-Hexane**	408.32 ± 3.25^{c}	144.64 ± 1.91^{b}
Dichloromethane	182.99 ± 1.86^{b}	17.64 ± 0.24^{a}
Ethyl acetate	102.58 ± 2.51^{a}	222.53 ± 2.55^{c}
Sign.	**	**

Data are expressed as media ± standard deviation (n= 3). Positive control: Orlistat, IC_{50} di 37.12 ± 1.10 μg/ml (lipase inhibitory test) and Acarbose, IC_{50} di 35.43 ± 1.15 μg/mL (α-glucosidase inhibitory test). Sign: significative. Differences were assessed using a One-way Analysis of Variance (ANOVA) test completed with a multiple comparison Tukey test (**$p < 0.01$). Values in the same column with different lowercase letters significantly differ.

Conclusion. Taking into account our results, *L. angustifolia* extracts and fractions deserve to be investigated for their chemical profile in order to prospect a potential use for the formulation of new products for the treatment of MetS. However, further studies will be needed to confirm its efficacy, as well as to prove the safety of the tested samples.

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