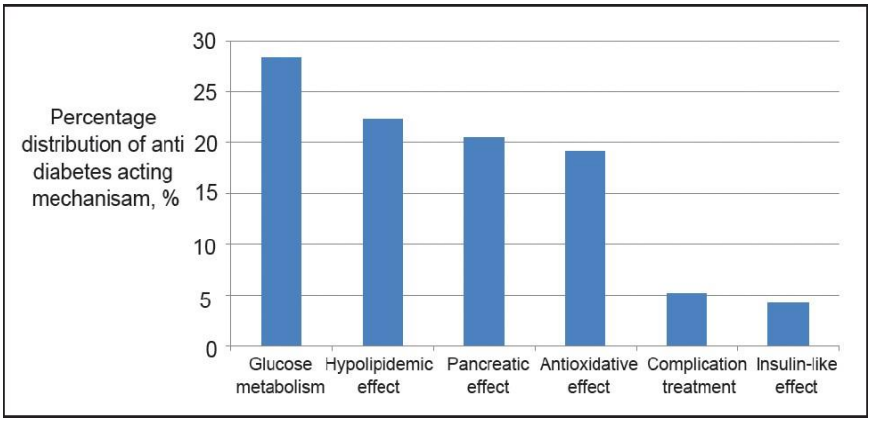
Anti-obesity and anti-diabetic properties of sage and chamomile extracts: effects on insulin resistance and lipogenesis, in both human subcutaneous and visceral adipose tissues

Background

In recent decades, there has been renewed interest in traditional and alternative medicine and thousands of potential medicinal plants have been screened to identify bio-active lead components. Over 1200 plants have been claimed to be remedies for diabetes, and more than 400 plants have been scientifically evaluated for type 2 diabetes treatment. The medicinal plants contain diverse bioactive compounds and can have multiple actions on insulin action, insulin production, or both.



Salvia officinalis (sage) has been used as alternative medicine to treat mild dyspepsia (such as heartburn and bloating), excessive sweating, age-related cognitive disorders, and inflammation in the throat and skin (Perry *et al*., 1999; Adams *et al*., 2007). The beneficial ant-inflammatory effects of sage methanol extract might be related to the high levels of phenolic compounds, particularly in rosmarinic acid (Jin *et al*., 2017). Studies have suggested that sage extracts enhance glycemic balance in normal and diabetic animals. Alarcon-Aguilar *et al*. (2002) showed that a water ethanolic extract from *S. officinalis* injected intraperitoneally had hypoglycemic effects in fasted normoglycemic mice and in fasted alloxan-induced mildly diabetic mice. In addition, Eidi & Zamanizadeh (2005) showed that sage methanolic extract given intraperitoneally, reduced significantly serum glucose in fasted streptozotocin (STZ)-induced diabetic rats without changes in plasma insulin levels.

Chamomile is a herbal plant that has been used for centuries in many human cultures to treat various inflammatory conditions such as eczema, ulcers, gout, neuralgia and rheumatic pains (McKay *et al*., 2006; Strivastava and Kupta 2007). The beneficial effects of chamomile are related to the presence of several flavonoid constituents and the core structure consists of either flavone (apigenin, luteolin) or flavonol-derivatives (quercetin, patuletin). Recent studies have demonstrated its antioxidant, hypocholesterolemic, anti-parasitic, anti-aging, and anticancer properties, supporting its longstanding traditional use for treating various human ailments (Soltani *et al*., 2018). It has been also reported that chamomile flowers extract chamomile activated peroxisome proliferator-activated receptor gamma (PPAR-γ) resulting in considerable therapeutic effects on type 2 diabetes and dyslipidemia in insulin-resistant high-fat diet (HFD)-fed mice (Weidner *et al*., 2013).

Research project

In high fat animal models of obesity and insulin resistance, we observed that sage extract exhibited similar effects to rosiglitazone. It improved insulin sensitivity *in vivo*, inhibited lipogenesis in mice adipocytes, and reduced plasma inflammatory markers (Ben Khedher *et al*., 2018). Our recent data (not yet published), supports the utilisation of sage and chamomile extracts as potentially effective anti-inflammatory agents in subcutaneous adipocytes.

Our research proposal aims to investigate the potential anti-obesity and anti-diabetic effect of both extracts:

- By the evaluation of their properties on the improvement of insulin sensitivity or the decrease of insulin resistance in subcutaneous and visceral human primary adipocytes.

- By measuring their effect on lipogenesis (lipid storage or accumulation), and on lipolysis (lipid breakdown or free fatty acid and glycerol release) in both fat tissues.

- Elucidate the underlying mechanisms involved in the biological activity of sage and chamomile on both glucose and lipid metabolism in both adipose tissue depots.

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This project will open new opportunities for using both plants as alternative medicines in the treatment of metabolic diseases such as obesity and type 2 diabetes.

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