SHORT COMMUNICATION

Biofunctional properties of *Eruca sativa* Miller (rocket salad) hydroalcoholic extract

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*Eruca sativa* Miller is a worldwide common alimentary plant (rocket leaves). The aim of this study was to correlate the potential in vitro scavenging activity of the *E. sativa* hydroalcoholic extract (HAE) with its in vivo hypoglycaemic effect. In DDPH free radical (DFR) and ferric-reducing antioxidant power assays, HAE in a concentration dependent manner (25–100 μg/mL) displayed a strong scavenging activity with maximum effect of 88% and 75% at 100 μg/mL, respectively. Daily administration of HAE (50 mg/kg; p.o.) in the in vivo model of alloxan-induced diabetic rabbits for 28 days showed significant reduction in glycaemia, also supported by recovery of body weight. In conclusion, our results give preliminary information on the potential use of this plant as a nutraceutical, useful to control and/or prevent a hyperglycaemic status.

**Keywords:** *Eruca sativa* Miller; rocket salad; hypoglycaemic activity; antioxidant

1. Introduction

Free radicals released during an oxidation process cause endogenous damage in humans and are associated with various diseases and disorder such as cancer, cardiovascular disease, inflammation, diabetes and immune function decline (Al-Rawi & Al-Rawi 2011; Wu & Schauss 2012). Diabetes is known to be associated with increased oxidative stress and impaired antioxidant defence mechanisms which are due to greater production of free radicals. The formation of free radicals in diabetes leads to a decrease in total antioxidant status of the body. Evidence that food consumption, especially some vegetable and fruits are related to a reduction of such disease comes from epidemiological studies (Villatoro-Pulido et al. 2012).

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The mechanisms by which vegetables and fruit exert their protective effects are not completely known but likely include antioxidant effects. The ‘diet’ in promoting health, via certain nutrients or dietary components, is nowadays a certainty rather than a mere speculation.

_Eruca sativa_ Miller is a diploid herbaceous plant belonging to the family Brassicaceae. This plant is native of Mediterranean area but is distributed worldwide. _E. sativa_, also known as rocket, rucola, rugula, colewort, roquette and arugula, is considered of high economic value and its leaves are usually consumed as green edible leaves. This plant is reported to exhibit antiscorbutic, diuretic and antiulcer activity. It is also used as a carminative and to alleviate abdominal discomfort and improve digestion (Barillari et al. 2005; Khan & Khan 2014; Landi et al. 2015). Besides glucosinolates, _E. sativa_ is also an excellent source of fibre, minerals and secondary metabolites such as ascorbic acid, flavonoids and carotenoids also known as antioxidants molecules that scavenge free radicals (Kim et al. 2007; Cavaiuolo & Ferrante 2014). On this basis, the current study aimed to assess in vitro the antioxidant activity of a HAE of this plant and also give preliminary in vivo evidence of its hypoglycaemic properties.

2. Result and discussion
An antioxidant is defined as ‘a substance that considerably suspends or inhibits an oxidation process’ (Gutteridge & Halliwell 1994). Antioxidant efficacy is likely correlate to the antioxidant ability to scavenge free radicals. In this study in order to assess the free radical scavenging effect of HAE, we have chosen DFR and ferric-reducing antioxidant power assays as they are the simplest ways of determining antioxidant power. The DDPH radical scavenging assay is an easy rapid and sensitive method for the antioxidant screening of plant extracts. HAE caused marked scavenging effect on DDPH with 47%, 59%, 74% and 88% results at 25, 75, 50 and 100 μg/mL, respectively, Figure S1 (See Figure S1 on supplementary data online only). At low pH, measuring the change in absorption at 593 nm can monitor reduction of a ferric complex to the ferrous form. The change in absorbance is directly related to the reducing power of the electron-donating antioxidants present in the reaction mixture. Figure S2 (See Figure S2 on supplementary data online only) shows the free radical scavenging activity of HAE. This extract, in a concentration dependent manner, yielded a percentage scavenging activities of 17%, 37%, 66% and 75% at concentrations of 25, 75, 50 and 100 μg/mL, respectively.

Diabetes is known to be associated with increased oxidative stress mediated mainly by hyperglycaemia-induced generation of free radicals (Ceriello 2003; Rahimi et al. 2005). The induction of experimental diabetes by systemic administration of alloxan is characterised, among other things, by the formation of reactive oxygen species (Heikkila et al. 1976). One of the targets of the ROS is the DNA of pancreatic islets (Asawa et al. 1991). In alloxan-treated animals, a significant increase in blood glucose level and decrease in body weight was evident.

Our results show a significant increase in blood glucose levels in alloxan-treated rabbits compared to those that received saline. The treatment with glibenclamide (5 mg/kg, p.o.), a well known antidiabetic drug, displayed a significant hypoglycaemic effect since 7 days whereas such effect, in a less extent manner, appeared at 21 days in HAE (50 mg/kg; p.o.) treated rabbits (See Figure S2 on supplementary data online only). We also took into account the growth of rabbits’ body weight. We observed an increase in body weight of normoglycaemic rabbits (≈40%) whereas the hyperglycaemics displayed only a partial increase (≈10%). On the other hand, after 28 days we observed a recovery of rabbits’ body weight using glibenclamide (GLB-treated rabbits) and _E. sativa_ hydroalcoholic extracts (HAE-treated rabbits) to treat the animals (≈20 and ≈13% of increase respectively).
3. Conclusion

In conclusion, our results demonstrate (i) a scavenging activity of HAE in vitro and (ii) a protective trend on alloxan-induced hyperglycaemic response in vivo. Taken together, these results suggest a potential use of this plant as a nutraceutical useful to provide extra health benefits.

Supplementary material

Experimental details related to this article along with Figures S1 and S2 are available online at http://dx.doi.org/10.1080/14786419.2015.1046380.

Conflict of interests

The authors of this article declared that there is no conflict of interests regarding the publication of this research article.

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