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In vitro analysis of antioxidant capacity of Indian yellow raspberry (*Rubus ellipticus* Smith.)

[1,2*]Sasikumar, J.M., [1]Poulin, R.C., [2]Meseret, C.E. and [3]Selvakumar, P.

[1]*Department of Biotechnology, School of Life Sciences, Karpagam University, Coimbatore 641021 (T. N), India*
[2]*Department of Biology, College of Natural and Computational Science, Haramaya University, Ethiopia*
[3]*School of Food Science, Postharvest Technology and Process Engineering, Haramaya University, Ethiopia*

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Abstract

We examined for first time the ripened fruits of Indian yellow raspberry (*Rubus ellipticus* Smith) (RE), an under exploited fruit from the Nilgiris, India, for its polyphenolic compounds and in vitro antioxidant/radical scavenging ability. The fruit yielded phenolic content (TPh) of 6100 ± 0.082 mg gallic acid equivalents (GAE)/100g of fresh material (FM) and total flavonoid content (TFl) of 320 ±0.120 mg quercetin equivalents (QE)/100g of fresh material (FM). The RE extract displayed excellent scavenging capacity towards 1, 1 – diphenyl – 2-picryl hydrazyl (DPPH·) (EC_{50} 9.85 ±1.33 µg mL^{-1}), superoxide anion ($O_2^{\cdot-}$) (EC_{50} 64.65 ±0.82 µg mL^{-1}), hydroxyl ion radicals ($^{\cdot}OH$) (EC_{50} 79.98 ±1.02 µg mL^{-1}) and nitric oxide (NO) (EC_{50} 75.21 ±1.32 µg mL_{-1}). The RE also showed strong reducing capacity (OD at 700 nm -1.435), strong Fe^{2+} chelation (EC_{50} 45.24 ±1.42 µg mL^{-1}) and exhibited remarkable reduction of lipid peroxidation (EC_{50} 71.1 ±0.22 µg ml^{-1}). The antioxidant capacities of the extract were comparable butyl hydroxytoluene (BHT), ethylene diamine tetraacetic acid disodium salt (EDTA-Na_2) and catechin. Significant and positive correlations were observed between polyphenolic contents and the antioxidant capacities, indicating that the phenolics were major contributors of the antioxidant property. Further, the separation of ethyl acetate (EtOAc) soluble fraction on a silica gel column afforded ellagic acid and quercetin. The results strongly point that Indian yellow raspberry may be a promising source of natural antioxidant agents.

Introduction

Increase in formation of reactive oxygen species (ROS) and reactive nitrogen species (RNS) is known to damage cellular biomolecules (DNA, proteins, lipids, amines and carbohydrates), resulting in a wide number of degenerative diseases (Sogut *et al*., 2003). In recent years, overwhelming epidemiological studies and intervention trails have consistently indicated the role of consumption of fruits and vegetables as antioxidants in the prevention of the degenerative diseases caused by free radicals (Scalbert *et al.*, 2005; Faller and Fialho, 2009; Wang *et al*., 2011). These protective effects of fruits are mostly related to the antioxidant components including vitamins, flavonoids, phenolic acids, and carotenoids (Prior, 2003). Previous research works have demonstrated the antioxidant activities and health benefits of the several fruits antioxidants (Kahkonen *et al*., 2001; Garcia-Alonso *et al*., 2004; Atawodi *et al.*, 2009). Therefore, it is of great interest in research concerning the antioxidant ability of fruits.

Rubus ellipticus Smith., commonly referred to as Indian yellow raspberry or Himalayan raspberry (Family Rosaceae), is a brambling raspberry with yellow fruits, native to tropical and subtropical India and Asia. It is found in the Nilgris (locally *"Mulli hannu"*) and Palni hills, southern India at an altitude of 1,800 m (Wealth of India, 1990). The aggregate of fruits are edible and, fruits and root are used in treating dysentery (Jain, 1991). Recent studies have confirmed that raspberries were rich repository of phenolic components and have been proved to posses excellent antioxidant properties (Deighton *et al.*, 2000, Halvorsen *et al*., 2002, Reyes-Carmona *et al.*, 2005; Wolfe *et al*., 2008; Zhang *et al.*, 2010). However, as far as we know, data on antioxidant capacity of Indian fruits is scarce. Recently, Sharma and Kumar (2011) reported *in vitro* antioxidant activity of *R. ellipticus* using DPPH scavenging capacity and reducing power. Phenolic contents and DPPH radical scavenging activity of *R. ellipticus* were reported (Karuppusamy *et al*., 2011). However, no extensive studies have so far been conducted on the antioxidant capacity of *R.*

*Corresponding author.
Email: *jmsashikumar@yahoo.co.in*