Antioxidant and antiproliferative activities of water spinach (Ipomoea aquatica Forsk) constituents

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Abstract. The aim of this study was to examine possible antioxidant and antiproliferative activities of 95% ethanol or water extract from water spinach (Ipomoea aquatica Forsk) organs. DPPH staining, total phenolic compounds, total flavonoid content, DPPH radical, reducing power method, FTC method, and inhibition of cancer cell proliferation were employed. Ethanol extract of stem demonstrated a positive effect in DPPH staining when it was diluted to 6.25 mg dry matter/mL while all other fractions showed no effect at the same dilution. This fraction also had the highest content of the total phenolic compounds, as well as the highest reducing power and FTC activity. Ethanol extract of leaf had the highest amount of flavonoids. Using DPPH colorimetric method, it was found that ethanol extract of stem had the highest radical-scavenging activity, followed by ethanol extract of leaf. The antiproliferative activities of water spinach extracts were studied in vitro using human lymphoma NB4 cells, and the following results were found: water extract of stem had the highest antiproliferative activity with an EC₅₀ of 661.40 ± 3.36 μg dry matter/mL, followed by ethanol extract of stem and ethanol extract of leaf. The water extract of leaf had the lowest antiproliferative activity (EC₅₀ >1000 μg dry matter/mL) under the experimental conditions.

Keywords: Antioxidant; Antiproliferative; Free radical; Water spinach.

Abbreviations: BHT, butylate hydroxyltoluene; DPPH, 1,1-diphenyl-2-picrylhydrazyl; EDTA, ethylenediamine tetraacetic acid; GSH, glutathione; FBS, fetal bovine serum; FTC, ferric thiocyanate; MTT, 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide; EC₅₀, dose with 50% efficiency.

Introduction

It is by now commonly accepted that under situations of oxidative stress, reactive oxygen species such as superoxide (O₂⁻), hydroxyl (OH⁻), and peroxyl (OÖ, ROÖ) radicals are generated. These reactive oxygen species play an important role in degenerative or pathological processes, such as aging (Burns et al., 2001), cancer, coronary heart disease, Alzheimer’s disease (Amin, 1993; Gey, 1990; Smith et al., 1996; Diaz et al., 1997), neurodegenerative disorders, atherosclerosis, cataracts, and inflammation (Aruoma, 1998). The use of traditional medicine is widespread, and plants are still a large source of natural antioxidants that might serve as leads for the development of novel drugs. Several anti-inflammatory, digestive, antinecrotic, neuroprotective, and hepatoprotective drugs have recently been shown to have an antioxidant and/or radical scavenging mechanism as part of their activity (Perry et al., 1999; Lin and Huang, 2002; Repetto and Llesuy, 2002). In searching for novel natural antioxidants, some plants have been extensively studied in the past few years for their antioxidant and radical scavenging components. These include echinacoside in Echinacea root (Hu and Kitts, 2000), anthocyanin (Espin et al., 2000), phenolic compounds (Rice-Evans et al., 1997), water extracts of roasted Cassia tora (Yen and Chuang, 2000), and whey proteins (Allen and Wrieden, 1982 a,b; Tong et al., 2000).

The aquatic plant water spinach (Ipomoea aquatica Forsk) grows wild and is cultivated throughout Southeast Asia and is a widely consumed vegetable in the region. Many of the waters where I. aquatica grows serve as recipients for domestic and other types of waste water. Because these waters contain not only nutrients, but often also a wide variety of pollutants, such as heavy metals from various human activities, many people risk poisoning. Water spinach is also supposed to possess an insulin-like activity according to indigenous medicine in Sri Lanka (Malalavidhane et al., 2000). Only a very few scientific studies have been conducted on its medicinal aspects. These include the inhibition of prostaglandin synthesis (Tseng et al., 1992) effects on liver diseases (Badruzzaman and Hussain, 1992), constipation (Samuelsson et al., 1992), and hypoglycemic effects (Malalavidhane et al., 2000).

The objectives of this work were to investigate the antioxidant and antiproliferation property of crude extracts from different tissues of water spinach in comparison with chemical compounds such as butylate hydroxyltoluene or reduced glutathione and the level of inhibition of the growth of cancer cells in a series of in vitro tests.