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Ethnomedicinal values, phenolic contents and antioxidant properties of wild culinary vegetables

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ABSTRACT

Ethnopharmacological relevance: Traditional medicines comprise a variety of health practices, approaches, knowledge, and beliefs. Documentation of traditional knowledge, estimation of total phenolics and antioxidant properties of plant species used as wild vegetables and in traditional medicines by the local communities of Lesser Himalayas-Pakistan are targeted.

Materials and methods: Interviews, questionnaires, and focus group conversation with local informants were carried out to record ethno-medicinal values. Used value, percentage of people who have traditional knowledge, preference ranking and informant consensus factors were also measured. Standard analytical methods were applied to estimate phenolic contents and antioxidant properties in water and acetone extracts.

Results: A total of 39 plant species used as culinary vegetables and to treat 44 different health disorders are investigated. Significant levels of use value (0.571) and preference ranking (58% PPK, PR-5) are calculated for *Ficus palmata*, *Ficus carica* and *Solanum nigrum*. Elevated levels of total phenolics (144.5 mg GAE/100 g, FW), and flavonoid contents (142.5 mg RtE/100 g, FW) were measured in the water extracts of *Origanum vulgare*, while *Ficus palmata* exhibits the highest flavonol contents (142.7 mg RtE/100 g, FW). Maximum DPPH activity is noted in the flowering buds of *Bauhinia variegata* (85.34%). However, highest values for OH^- radical scavenging activity (75.12%), Fe^{3+} reducing antioxidant power (54.50 μM GAE/100 g, FW), and total antioxidant capacity (180.8 μM AAE/100 g, FW) were measured in the water extracts of *Origanum vulgare*.

Conclusion: Lesser Himalayas is a rich source of traditional cultural heritage, and plant biodiversity, which are under threat and necessitate urgent documentation. Present study is focused on the plant species used in traditional medicines and culinary vegetables as well. Preliminary determinations of phenoloic contents and antioxidant properties of various plant species were carried out. Present work will introduce new resource of medicinal and food plants, which could be used as functional food. Furthermore, phytochemical profiles, cellular based antioxidant properties, and isolation of active ingredients will be useful for consumers, and in the pharmaceutical and nutraceutical industries of the country.

1. Introduction

Ethnomedicines comprise a variety of health practices, approaches, knowledge, religious therapies, manual techniques, and beliefs on plant, animal, or mineral based medications to treat, identify, or prevent diseases (WHO, 2001). About 50,000 species out of half million flowering plants are used as medicinal plants (Schippmann et al., 2002; Govaerts, 2001). World Health Organization has reported that more than 60% of the world's population in developing countries depends on medicinal plant species (MPs) to treat various ailments (WHO, 2010). The study of medicinal plants and their uses is one of the most primary human concerns (MacDonald, 2009). MPs are gaining much attention in rural areas of the world because of their cultural value, efficacy, less side effects, growing price of contemporary allopathic medicines, and deficiency of modern health facilities (Heinrich, 2000; Tabuti et al., 2003; Verma and Singh, 2008). In recent times researchers across the world are showing immense interest in the traditional uses of

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MPs (Jabbar et al., 2007), because such ethnomedicinal studies are valuable in enlightening important indigenous plants species, mainly to discover novel drugs. At present, various drugs which are available in the form of crude extract, powder, mixture or simplest parts in herbal markets are derived from MPs (Saqib et al., 2013).

Recent investigations have revealed that plants produce variety of chemicals to protect themselves as well humans from various diseases and pathogens. Over 5000 phytochemicals have been identified, out of which a small fraction has been studied closely, while a large percentage still remains unknown (Shahidi and Naczk, 1995) which must be identified for health benefits. Plant based phenolic compounds have long been known as effective antioxidants, free radical scavengers, and exhibit antimicrobial, anti-inflammatory, anti-allergic, hepato-protective, anti-carcinogenic and vasodilatory actions (Brown, 1995; Soobrattee et al., 2005; Aliyu et al., 2008). Effectiveness of plant species against wide array of microorganisms is due to flavonoids (Madsen et al., 1996; Lovkova et al., 2001), which play significant role in the protection of lipids and vital cell components from damaging oxidation, besides providing bright colors to petals in plants (Escarpa and González, 2000). Flavonoids prevent cardiovascular disorders, and are potent scavengers of singlet oxygen and a variety of free radicals, which are perhaps concerned with DNA damage and tumor promotion (Marchand, 2002). Natural antioxidants have attained considerable interest now because of their safety and potential nutritional and therapeutic values. Increasing interest in plant based natural antioxidants has led to the antioxidant assessment of many medicinal and food plant species (Kahkonen et al., 1999; Velioglu et al., 1998; Wolfe et al., 2003; Liyana-Pathirana and Shahidi, 2005).

It has been estimated that approximately 6000 plant species are found in Pakistan, including 372 endemic species. About 456 medicinal plants are traded actively that are used to synthesize nearly 350 formulated drugs (Ahmad and Husain, 2008). Though a number of surveys on the traditional uses of MPs in the Himalayan region of Pakistan have been conducted before (Abbasi et al., 2009, 2010, 2012, 2013a, 2013b, 2013c; Ahmed et al., 2013; Akhtar et al., 2013; Bano et al., 2013; Barkatullah et al., 2009; Fahad and Bano, 2012; Ibrar et al., 2007; Khan et al., 2014; Mahmood et al., 2011, 2012; Qureshi et al., 2007; Saqib et al., 2013; Shah and Hussain, 2012; Shah et al., 2014; Shaheen et al., 2012; Sher et al., 2011; Shinwari and Gilani, 2003; Shinwari and Khan 2000), ethnomedicinal aspects and estimation of phenolic contents and antioxidant activities of medicinal and food species have never been reported. Present study is focused on the documentation and evaluation of traditional knowledge and preliminary assessment of phenolic contents and *in-vitro* antioxidant properties of plant species used as food (culinary vegetables) and medicinal plants by the local communities of Lesser Himalayas-Pakistan.

2. Materials and methods

2.1. Study site

Ethnobotanical survey is carried out from March 2012 to April 2014 in 40 different localities of the three districts (Haripur, Abbottabad and Mansehra) of Lesser Himalayas within the Khyber Pakhtunkhwa (KPK) province, Pakistan (Fig. 1). The survey area lies between 33°-44′ and 35°-35′ north latitude and between 72°-33′ and 74°-05′ east longitude. The vegetation of the area falls in subtropical, temperate, sub-alpine and alpine zones, and average rainfall varies from 70 to 130 mm (Hussain and Ilahi, 1991; Khan et al., 2010). Abbasi, Jadoon, Karlal, Gujjar, Dhund, Awan and Syed are the major tribes. The primary language is Hindko (75% and 94%) in urban and rural areas respectively, with Punjabi, Pashto and Urdu (Shah et al., 2014).

2.2. Ethnobotanical data collection and analysis

Participatory rural appraisal (PRA) approaches were adopted during fieldwork, and prior informed consent was obtained before conducting interviews. A total of 60 informants ranged between 25 and 80 years, which include local inhabitants, well-informed persons and traditional healers (hakims), were interviewed. Information regarding the local plant names, part(s) used, methods of preparation, application and diseases cured were documented. Taxonomic identification of the plant samples was carried out by the expert taxonomist in Quaid-i-Azam University Islamabad, and with the help of Flora of Pakistan (Ali and Qaiser, 1995–2005). The botanical names and respective families were allocated according to angiosperm phylogeny group (APGIII, 2009) and The Plant List (2010). Ethnobotanical tools used to evaluate the information obtained through interviews and questionnaires are given below,

a) *UVi*: used values were calculated as reported earlier (Phillips et al., 1994), to determine the relative magnitude of the plant species.

$$UVi = \sum Ui/Ni$$

where *Ui* represents the number of usage reports cited by each informant for a given plant species *i* and *N* is the total number of informants interviewed for a given plant species.

b) *PPK* value: the percentage of people having traditional knowledge about the use of a plant species used in the treatment of various diseases is estimated using the formula

$$PPK = (n/N) \times 100$$

where *n* is the number of informants citing the species, while *N* represents the total number of informants.

c) PR: preference ranking method is used to rank the medicinal plants according to their level of effectiveness. Each rank is a given numeral (1, 2, 3, 4 or 5), with the most effective plants assigned a value of 5 as reported by Asase et al. (2005).

d) ICF: informant consensus factor on reported treatments of medicinal plants for a given group of aliments is obtained by following the method of Heinrich et al. (1998). All the reported human diseases were grouped into eight categories that include gastrointestinal disorders, skin infections, rheumatoid problems, respiratory diseases, fever/cold/respiratory diseases, reproductive disorders, liver/kidney diseases, inflammation/sedative, and parasites/worms. ICF values for medicinal plants are calculated by the following formula as previously reported (Heinrich et al., 1998).

$$ICF = \frac{NU_r - Nt}{NU_r - 1}$$

where *NUr* represents number of usage citations in each category and *Nt* is the number of species used.

2.3. Phenolic contents and antioxidant properties

Freshly collected samples were washed carefully with tap water followed by the distilled water, then placed in a paper wrapper and dried at 55–65 °C for 24 h in an electric oven (Abuye et al., 2003). The dried samples were ground with a porcelain pestle and a mortar; fine powder was sieved through muslin cloth, stored in polythene bottles and kept in desiccators until study.