SECTION I

Introduction
In recent years, there has been a global trend towards the use of phytochemicals in nutraceuticals and functional foods. Phytochemicals are a large group of non-nutrient and nutrient compounds that are biologically active, including phenolic compounds, terpenoids, alkaloids, carotenoids, lignans, fibre etc. Scientific evidence is accumulating to support the role of phytochemicals in the prevention and treatment of diseases. Recent studies on phytochemicals highlight their role as antioxidant, antimutagen, anti-inflammatory, anticoagulant, antilipidemic, and antimicrobial to name a few (Craig, 1999; Dillard & German, 2000; Youdim & Joseph, 2001).

Oxidative stress that releases free oxygen radicals in the body has been implicated in a number of disorders including cardiovascular ailments, cataracts, cancers, rheumatism, and many other autoimmune diseases besides aging (Halliwell & Gutteridge, 1999; Willcox et al., 2004). Phenolic phytochemicals are multifunctional. They can act as free radical scavenger, reducing agent, metal chelating, singlet oxygen quencher, and inhibitor of lipid peroxidation (Rice-Evans et al., 1997). Research in the recent past have accumulated enormous evidences advocating enrichment of body systems with natural antioxidants to correct vitiated homeostasis and prevent the onset as well as treat diseases caused/fostered due to oxidative and related oxidative stress (Cao et al., 1998; Kaur & Kapoor, 2001). In food systems, oxidation of lipids resulting in rancidity and deterioration of sensory properties of food pose a major problem for both consumers and food manufacturers. Antioxidants play an important role in preventing undesirable flavour and maintaining the nutritional quality of the food (Shahidi & Wanasundara, 1992).
The first attempts to stabilize food products against lipid oxidation occurred more than 60 years ago (Pokorny, 1991). The most widely used synthetic antioxidants, butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA), have been restricted recently because of serious concerns about their carcinogenic and mutagenic potential. Therefore, there is great interest in finding new and safe antioxidants from natural sources (Pokorny 1991; Rajalakshmi & Narasimhan, 1996). A large number of plants have been screened as viable sources of natural antioxidants. Herbs and spices or their extracts as well as tea extracts have been shown to extent the shelf life of various foods. Recent studies have led to the identification of active ingredients and antioxidant components in rosemary, rice hulls, green tea, canola seed, and ginger. Some of these extracts have been successfully commercialized in Japan, Europe, and North America. Few plant constituents have been demonstrated to have positive effects when tested against oxygen reactive compounds in biological systems. The importance of plant-based antioxidants in foods is appreciated for preserving foods against oxidative deterioration as well as supplying the essential antioxidants in vivo (Shahidi, 1997).

The plant-derived antimicrobials such as essential oil and extracts or active constituents have received considerable attention for controlling microbial growth in food materials as well as for preventing or treating infectious diseases as alternative to chemical preservatives. The major phytochemical antimicrobials include phenolic compounds, aliphatic alcohols, terpenes, aldehydes, ketones, and alkaloids (López-Malo et al., 2005).
Excellent reviews are available in the literature on antimicrobial properties, mode of application, and mechanism of action of phenolic compounds (Zaika, 1988; Davidson, 2001). More than 1340 plants have been recognized as potential sources of antimicrobial agents. Among them, thyme and oregano have been found as potent antimicrobial agents (Wilkins & Board, 1989).

Since time immemorial, plants have been used for their medicinal properties such as hypotensive, hypocholesterolemic, and hypoglycemic effects (Shylaja & Peter, 2004). Many plants and their active constituents have been found as antiatherosclerotic and antitrombotic agents. The potential role of some dietary components from plant sources such as garlic, onion, and ginger against platelet aggregation has been recognized (Srivastava, 1984; 1986 a,b,c).

In India, a variety of native herbs are widely used for a host of common ailments and conditions such as anxiety, arthritis, colds, infections, intestinal disorders and so on. Some of the more popular herbs in use today are aloe vera, echinacea, garlic, ginseng, goldenseal, and ginkgo to name a few (Craig, 1999). India with its biodiversity can provide safe plant derived antioxidants compatible with different food products. Although the antioxidant and antimicrobial potential of many plants and their constituents have been identified, scientific information on the nutritional and pharmacological properties of many plants, particularly those that are less widely used for culinary purposes is still scarce. Therefore, the assessment of such properties remains an interesting and useful task, particularly for finding new sources for
natural antioxidants, functional foods and nutraceuticals. On the other hand, chemical and biological diversity of plants depending on such factors as cultivation area, climatic conditions, vegetation phase, genetic modifications and others is an important impetus to study flora present in different growing sites, countries and geographical zones. In addition, consumers' demands for natural products are increasing due to increased awareness regarding diet-related health problems and concerns about the toxicological side effects of synthetic additives. From the consumer point of view, it is important to study the effect of various processing treatments on the antioxidant activity of plant products in order to exploit their benefits.

The present research work targets on the leaves of three economic and commonly available Indian plants, namely, *Moringa oleifera*, *Morus indica*, and *Mentha spicata*. Although few reports are available on the antioxidant properties of selected samples, their potential in food and biological systems has not been explored extensively. A brief introduction of selected plants is presented here.

* *Moringa oleifera* L. (drumstick) belonging to the family Moringaceae, is an extensively available Indian plant with each part of the tree having amazing therapeutic properties. *Moringa* leaves have been used in the traditional medicine passed down for centuries in many cultures. The leaves are considered to offer great potential for those who are nutritionally at risk. Scientific researches have indicated a wide range of pharmacological properties of *Moringa* leaves such as anti-inflammatory, antimicrobial,
hypotensive, hypocholesterolemic etc. The tree has adapted itself to local conditions, resulting in many variations. Thus, localized studies are needed to test the leaves' effects in different areas.

*Morus indica* L. (mulberry) belonging to the family Moraceae, is a fast growing deciduous plant that is valued for its foliage as the best feed for silkworms. Mulberry leaves are quite nutritious, palatable, and non-toxic. They have been traditionally used as hypoglycemic, hypotensive, and diuretic agents. Scientific evidences are available on the nutritional and medicinal properties of mulberry leaves.

*Mentha spicata* L. (spearmint) belonging to the family Labiatae, is one of the most important essential oil-bearing plants due to its worldwide production and use as flavouring agent in the food, cosmetic, and pharmaceutical preparations. Leaves of spearmint are good sources of nutrient components and have been used in the traditional medicine as carminative, stimulant, antispasmodic etc.

The objectives of the present investigation were:

- Extraction and characterization of phytochemicals of selected plant materials
- Evaluation of antioxidative properties of plant extracts
- Evaluation of biological activities of plant extracts - *in vitro*
- Application of plant extracts in model food systems