1. Introduction
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The haematological disorders include various types of anaemia where the patient having deficiency or reduction of haemoglobin content. Anaemia is a global public health problem affecting both developing and developed countries with major consequences for human health as well as social and economic development. It occurs at all stages of the life cycle, but is more prevalent in pregnant women and young children. In 2002, iron deficiency anaemia (IDA) was considered to be among the most important contributing factors to the global burden of disease. Anemia is a decrease in the number of red blood cells (RBCs), a decrease in the amount of hemoglobin, or both a decrease in the number of RBCs and hemoglobin. When there is an insufficient amount of hemoglobin to deliver oxygen to the tissues, anemia exists. Among the other causes of anaemia, heavy blood loss as a result of menstruation, or parasite infections such as hookworms, ascaris, and schistosomiasis can lower blood haemoglobin (Hb) concentration. Acute and chronic infections, including malaria, cancer, tuberculosis and HIV can also lower blood Hb concentration. The presence of other micronutrient deficiencies, including vitamins like A, B₁₂, folic acid, riboflavin, and trace elements like iron, copper, zinc can increase the risk of anaemia. Furthermore, the impact of haemoglobinopathies on anaemia prevalence needs to be considered within some populations. Globally, the most significant contributor to the onset of anaemia is iron deficiency so that IDA and anaemia are often used synonymously, and the prevalence of anaemia has often been used as a proxy for IDA. It is generally assumed that 50% of the cases of anaemia are due to iron deficiency, but the proportion may vary among population groups and in different areas according to the local condition. The main risk factors for IDA include a low intake of iron, poor absorption of iron from diets having high concentration of phytate or phenolic compounds, and period of life when iron requirements are especially high (i.e. growth and pregnancy) (Rang and Dale, 2003; Williams and Lemake, 2002; Watkins and Renau, 2003; Karimi et al., 2004; Malhotra et al., 2004; McLean et al., 2008; Seth & Seth, 2009).
Anemia is one of the most common health problems in India. The problem is much more in rural than the urban area. The high-risk groups for anemia are pregnant and lactating females and children. Prevalence in this subgroup has been found to vary from 50 - 90% in different parts of India. Almost all interventions at national and local level have focused predominantly on these groups. Reliable data on the prevalence of anemia in adult population (non-pregnant females and adult males) is not available. The prevalence of anemia in 16 - 70 years age group was 47.9%. The prevalence of anemia was higher among females (50%) than males (44.3%). The prevalence of mild anemia was higher (males 29.3%; females 32%) than moderate and severe anemia in this population. Prevalence of anemia was maximum (52.8%) in the age group of more than 45 years among males whereas among female subgroup, younger females (<30 years) had higher prevalence of anemia (55%). Both males and females, who were uneducated, smokers, belonging to low socioeconomic status and having low or normal body mass index had higher prevalence of anemia (Malhotra et al., 2004).

According to a UNICEF report, two billion people suffer from anemia worldwide and most of them having IDA, especially in underdeveloped/developing countries, where 40-50% of children under age five are suffering from IDA (Karimi et al., 2004). The highest prevalence is in preschool-age children (47.4%) and the lowest prevalence is in men (12.7%). However, the population group with the greatest number of individuals affected is non-pregnant women (468.4 million). WHO regional estimates generated for preschool-age children and pregnant and non-pregnant women indicate that the highest proportion of individuals affected are in Africa (47.5–67.6%), while the greatest number affected are in South-East Asia where 315 million individuals in these three population groups are affected (Table 1.1). The level of anaemia as the public health problem across countries is illustrated by maps for preschool-age children and pregnant and non-pregnant women in Figure 1.1 (Bruno de Benoist et al., 2008).
## Table 1.1: Anaemia prevalence affected in preschool – age children, pregnant women, and non – pregnant women in each region as per WHO#.

<table>
<thead>
<tr>
<th>WHO region</th>
<th>Prevalence (%)</th>
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<tbody>
<tr>
<td></td>
<td>Preschool-age children</td>
<td>Pregnant women</td>
<td>Non-pregnant women</td>
<td></td>
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<tr>
<td>Africa</td>
<td>64.3 – 71.0</td>
<td>52.8 – 61.3</td>
<td>43.4 – 51.6</td>
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<tr>
<td>Americas</td>
<td>26.8 – 31.9</td>
<td>17.3 – 30.8</td>
<td>12.9 – 22.7</td>
<td></td>
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<tr>
<td>South–East Asia</td>
<td>61.0 – 70.0</td>
<td>43.9 – 52.5</td>
<td>41.9 – 49.4</td>
<td></td>
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<tr>
<td>Europe</td>
<td>15.4 – 28.0</td>
<td>18.6 – 31.6</td>
<td>14.7 – 23.3</td>
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<tr>
<td>Eastern Mediterranean</td>
<td>42.2 – 51.2</td>
<td>38.2 – 50.3</td>
<td>29.2 – 35.6</td>
<td></td>
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<tr>
<td>Western Pacific</td>
<td>21.9 – 24.4</td>
<td>28.8 – 32.7</td>
<td>20.8 – 22.2</td>
<td></td>
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<tr>
<td>Global</td>
<td>45.7 – 49.1</td>
<td>39.9 – 43.8</td>
<td>28.7 – 31.6</td>
<td></td>
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#Bruno de Benoist et al., 2008.

![Figure 1.1a: Anaemia as a public health problem by country: Preschool – age children (Bruno de Benoist et al., 2008).](image-url)
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Figure 1.1b: Anaemia as a public health problem by country: Pregnant women (Bruno de Benoist et al., 2008).

Figure 1.1c: Anaemia as a public health problem by country: Non – pregnant women (Bruno de Benoist et al., 2008).
Asthma is a Greek word which means ‘breathless’ or ‘to breathe with open mouth’. The Global Strategy for Asthma Management and Prevention Guidelines define asthma as ‘a chronic inflammatory disorder of the airways associated with increased airway hyper-responsiveness, recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night/early morning. Airway inflammation produces airflow limitation through acute bronchoconstriction, chronic mucus plug formation and airway wall swelling or remodelling. These symptoms may be relieved either spontaneously or after treatment. Asthma can occur at any age (Murthy and Sastry, 2005). Generic susceptibility and personal/family history of atopy along with environmental exposures produce the clinical symptomatology of asthma. These signs and symptoms are highly variable in severity and duration (Seth & Seth, 2009). Acute asthma attacks are triggered by a variety of stimuli, including exposure to allergens or cold air, exercise, and upper respiratory tract infections. Recently, a number of genetic polymorphisms have been associated with an increased risk of developing asthma. Thus, genetic factors probably contribute to the exaggerated response of the asthmatic airway to various environmental challenges. The most severe exacerbation of asthma, status asthmaticus, is a life-threatening condition that requires hospitalization and must be treated aggressively. Unlike most exacerbations of the disease, status asthmaticus is by definition unresponsive to standard therapy (Torphy and Douglas, 2008).

Asthma has become more common in both children and adults around the world in recent decades. The increase in the prevalence of asthma has been associated with an increase in atopic sensitization, and is paralleled by similar increases in other allergic disorders such as eczema and rhinitis. The rate of asthma increases as communities adopt western lifestyles and become urbanized. With the projected increase in the proportion of the world's population that is urban from 45% to 59% in 2025, there is likely to be a marked increase in the number of asthmatics worldwide over the next two decades. It is estimated that there may be an additional 100 million persons with asthma by 2025 (Masoli et al., 2003). Asthma is thought to affect about 3% of the population in most countries. The highest prevalence (almost 30%) is found in New Zealand. The prevalence in a number of countries falls in the
range of 10%–17% (Murthy and Sastry, 2005). Figure 1.2 shows the prevalence of asthma in the world.

![Map showing the prevalence of asthma in the world](image)

**Figure 1.2: The prevalence of asthma in the world (Masoli et al., 2003).**

There are only a few studies from India on field epidemiology of asthma. In a study conducted more than 30 years ago, prevalence of asthma was reported as 2.78% in an urban population aged 30-49 years. It was also reported in the same study that the prevalence in morbidity surveys of Government employees and their families in Delhi was 1.8% (Aggarwal et al., 2006). According to the National Family Health Survey-2 (NFHS-2) report the estimated prevalence of asthma in India is 2468 per 100,000 persons. The prevalence was higher in rural than in urban areas. The prevalence among males was slightly higher than among females. Among those below 15 years of age, asthma was seen in 950 per 100,000 persons. The prevalence of asthma in adult males (18 years and above) during 1995–97 was 3.94% in urban and 3.99% in rural areas. In females of the same age group, the prevalence was 1.27% in urban as well as rural areas. Increasing in prevalence is associated
with spreading urbanization, exposure to domestic mites, vehicle exhausts, smoking, allergens and family history (Murthy and Sastry, 2005).

Drugs so far invented for the treatment includes $\beta_2$ agonists, anticholinergics, corticosteroids, phosphodiesterase inhibitors, leukotriene modifiers, PAF inhibitor, TXA$_2$ inhibitor etc. Still newer molecules are being investigated on the basis of the new mechanisms involved. Specific $\beta_2$ agonists and xanthine derivatives like theophylline or their combination are most commonly used by majority of asthmatic patients from mild to severe asthma in the tablet form. However, it has been reported that their prolong treatment produce variable adverse effects. Muscle tremor and hypokalemia are major adverse effects of $\beta_2$ agonists. Theophylline has narrow therapeutic index and requires monitoring of drug levels. Glucocorticoids are used as an anti-inflammatory drug but they have no immediate effect on the early bronchoconstriction response to allergen or exercise. Steroids reverse tolerance to $\beta$-adrenergic agonists and increase the density of $\beta$-adrenergic receptors. Glucocorticoids cause adrenal suppression and variable adverse effects on prolong therapy.

The growing environmental pollution with rapid and extensive industrialization is also responsible for aggravation of this disease. The alarming rise in the incidence of this disease in metropolitan cities has posed a serious problem (Williams and Lemake, 2002; Watkins and Renau, 2003; Rang and Dale, 2003; Undem, 2006).

About 70 – 80% of the world populations, particularly in the developing countries, rely on non-conventional medicine in their primary healthcare as reported by the WHO. In recent years, there has been growing interest in alternative therapies and the therapeutic use of natural products, especially those derived from plants. This interest in drugs of plant origin is due to several reasons, namely, conventional medicine can be ineffective (e.g. side effects and ineffective therapy), abusive and/or incorrect use of synthetic drugs results in side effects and other problems, a large percentage of the world’s population does not have access to conventional pharmacological treatment, and folk medicine and ecological awareness suggest that “natural” products are harmless. However, the use of these substances is not always authorized by legal authorities dealing with efficacy and safely procedures,
and many published papers point to the lack of quality in the production, trade and prescription of phytomedicinal products. About 25% of the drugs prescribed worldwide come from plants, 121 such active compounds being in current use. Of the 252 drugs considered as basic and essential by the WHO, 11% are exclusively of plant origin and a significant number are synthetic drugs obtained from natural precursor (Raghavendra et al. 2009).

For centuries people have used plants for healing. Plant products – as parts of foods or botanical portions and powders – have been used with varying success to cure and prevent diseases throughout history. Uses of indigenous drugs from plant origin are the major sources as an alternative system of medicine or traditional system of medicine since ancient (Joshi et al., 2004). Traditional system of medicine involves the use of herbs, animal parts and minerals. It also includes acupuncture, manual therapy and spiritual medicines. As per the report of the Inter Regional Workshop on Intellectual Property Rights, the world market for traditional systems of medicine including herbal products and the raw materials has been estimated to have an annual growth rate of 5 to 15% and the total global herbal market may reach to five trillion US dollars by 2050. As per statistical data the Indian medicinal plant based industry is growing at the rate of 7 to 15% per annum. The value of botanicals related trade is about US $10 billion per annum with annual export of US $1.1 billion in India, while China’s annual herbal drug production is worth US $48 billion with export of US $3.6 billion. Presently, the United States is the largest market for Indian botanical products accounting for about 50% of the total exports. Global trend leading to increasing demand of medicinal plants for pharmaceuticals, phytochemicals, neutraceuticals, cosmetics and other products is an opportunity sector for Indian trade and commerce (Singh et al., 2003, Raghavendra et al. 2009).

WHO define the traditional system of medicine as diverse health practice, approach, knowledge and belief incorporating plant, animal and / or mineral based medicine, spiritual therapy, manual technique and exercise applied singularly or in combination to maintain well being as well as to treat, diagnose or prevent illness. This system aims to promote healthy and enhance quality of life. The concept of constitutional uniqueness of human individuals
leading to prescription of suitable drugs and specific diet is a remarkable feature of traditional medicines (Patwardhan et al., 2006).

The R & D thrust in the pharmaceutical sector is focused on development of new drugs, innovative or indigenous processes for known drugs and development of plant based drugs through investigation of leads from traditional systems of medicine. Neutraceuticals and cosmeceuticals are of great importance as a reservoir of chemical diversity aimed at new drug discovery and are explored for antimicrobial, cardiovascular, immunosuppressant and anticancer drugs (Patwardhan et al., 2004). Natural products including plants, animal and minerals have been the basis of treatment of human diseases. Numerous molecules have come out of experimental base; examples include rauwolfia alkaloids for hypertension, holarrhena alkaloids in amoebiasis, guggulsterones as hypolipidemic agents, piperidine as bioavailability enhancer, curcumines in inflammation and picrosides in hepatic protection (Patwardhan and Hooper, 1992).

Drug discovery is no longer a game of chance or just limited to the availability of new technology but it is a better understanding of various approaches and key learning from the past with the appropriate strategy for the future is essential to make a significant difference (Schmid and Smith, 2004). During the past few years a large number of approved new drug applications have originated from the biotechnology industry and analysts expect a continuation of pharmaceutical-biotechnology alliances to help expand pipelines (Hughes, 2009). Similarly, natural products have contributed nearly half of all small molecules approved in this decade. It has been suggested that the current drug discovery approach of finding ‘new entity drugs’, if shifted to ‘combining existing agents’ may be helpful. Therefore natural product drug discovery based on ethnopharmacology and traditional medicines may also be considered as attractive strategic options (Kong et al., 2009).

The social expectation about drug safety and efficacy are rising while R & D productivity in the pharmaceutical industry is not met the requirements. The critical path initiative of FDA was intended to modernize drug development by incorporating recent scientific advances, shows a proactive policy approach to enhance innovation opportunities in a public/private partnership model (Woodcock and Woosley, 2008). It is suggested that traditional medicine may
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offer better routes to the discovery, development and delivery of new drugs with enhanced performance in terms of cost, safety and efficacy. To this end, it is also believed that the basic principles, experiential wisdom, holistic approach and systematic database of Ayurveda may offer useful bio prospecting tools and an efficient discovery engine (Patwardhan et al., 2004). The mass screening of plants in the development of new leads or drugs are tremendous expensive and inefficient. But the traditional knowledge based on bio prospecting offered better leads for the treatment of AIDS and cancer. About 60% of anticancer and 75% of anti-infective drugs approved from 1981 to 2002 was developed from natural origins (Gupta et al., 2005). A multidisciplinary approach combining natural product diversity with total, combinatorial synthetic and biosynthesis may provide a useful solution to the current innovation quandary (Newman and Cragg, 2007).

Earlier, the term reverse pharmacology has been used in relation to ligand-independent orphan functions that can modulate well-defined drug targets, but this review does not cover such aspects (Angelique and Ralf, 2008). Reverse pharmacology is defined as a rigorous scientific approach of integrating documented clinical experiences and experimental observation into lead by transdisciplinary exploratory studies and further developing these into drug candidates or formulations through robust preclinical and clinical research (Vaidya and Devasagayam, 2007). In this process ‘safety’ remains the most important starting point and the efficacy becomes a matter of validation. The novelty of this approach is the combination of living traditional knowledge such as Ayurveda and the application of modern technology and processes to provide better and safer leads.

It is suggested that drug discovery need not be always confined to the discovery of a single molecule. Many analysts believe that the current ‘one drug fits all’ approach may be unsustainable in the future. The growing interest in polypill concept is indicative of the need to collectively address multiple targets, risk factors or symptoms (Kumar et al., 2008). In the management of polygenic syndromes and conditions there is renewed interest in multi-ingredient synergistic formulations (Zimmermann et al., 2007). The rationally designed polyherbal formulations also could be explored as an option for multitarget therapeutic and prophylactic applications. Both
traditional medicines and Ayurveda, over thousands of years have been developed various practical theories to create polyherbal formulations in which multiple agents contained in one formula act synergistically (Hong-Fang Ji et al., 2009).

Development of standardized, synergistic, safe and effective traditional herbal formulations with robust scientific evidence can also offer faster and more economical alternatives. Ayurvedic texts include thousands of single or polyherbal formulations (Anonymous, 2003). These have been rationally designed and have been in therapeutic use for many years. Sufficient pharmacoepidemiological evidence, based on actual clinical use, can be generated to support their safety and efficacy (Vaidya et al., 2003). Systematic data mining of the existing formulations’ huge database can certainly help the drug discovery processes to identify safe, effective and synergistic formulations.

The World Health Organization’s Commission on Intellectual Property and Innovation in Public Health has also recognized the promise and role of traditional medicine in drug development for affordable health solutions (Patwardhan, 2005). India, China, Korea, Malaysia, Brazil, South Africa, Australia and number of other countries are becoming increasingly aware of the value of their traditional knowledge. On the other hand, the global pharmaceutical industry is looking for innovative solutions to expedite the discovery process. Therefore, innovative approaches inspired by traditional knowledge like Ayurveda and folkloric uses may aptly occupy this niche strategy to expedite drug discovery and development process especially in the existing global economic environment (Patwardhan and Mashelkar, 2009).

Ayurvedic physicians suggest leafy green vegetables for the treatment of haematological disorders as a source of iron and other minerals. Various herbs used in anaemia are *Ageratum conyzoides*, *Boerhavia diffusa*, *Centella asiatica*, *Hemidesmus indicus*, *Ichnocarpus frutescens*, *Momordica charantia*, *Moringa oleifera*, *Phyllanthus amarus*, *Phyllanthus emblica*, *Punica granatum*, *Ocimum tenuiflorum*, *Solanum americanum* (Silja et al., 2008), *Adenia gummifera*, *Allophylus rubifolius*, *Albizia versicolor*, *Brackenridgea zanguebarica*, *Bridelia cathartica*, *Conniphora africana*, *Hibiscus sabdariffa*,
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*Lannea stuhlmanni, Sorgum bicolor, Theobroma cacao, Triumfetta rhomboidea* etc. (Omolo el al. 1997; Falade et al. 2005; Oladiji et al. 2007).

An ancient system of Indian medicine has also recommended a number of drugs from indigenous plant sourced for the treatment of bronchial asthma and allergic disorders (Charaka Samhita, 1949). Various herbs used in asthma are *Achyranthes aspera, Adhatoda vasika, Albizia lebbeck, Artemisia caerulenscens, Boswellia serrata, Calotropis gigantea, Calotropis procera, Cedrus deodara, Clerodendron serratum, Curcuma longa, Eugenia caryophyllis, Eleocarpus spharicus, Inula racemosa, Ocimum sanctum, Picrorrhiza kurroa, Piper longum, Sarcostemma brevistigma, Solanum xanthocarpum, Tephrosia purpurea, Tinospora cordifolia, Tylophora asthmatica, Vitex negundo* etc. (Gokhale & Saraf, 2002).

The fruit of *Opuntia* is considered a refrigerant, and is said to be useful in gonorrhea. The baked fruit is said to be given in whooping cough and syrup of the fruit is said to increase the secretion of bile and control spasmodic cough and expectoration (Kirtikar and Basu, 1999; The Wealth of India, 2001). The fruits of *Opuntia elatior* Mill., commonly known as “Hathlo Thor” belongs to family Cactaceae, are use as haematinic, anti-asthmatic and spasmolytic action by tribal people of Saurashtra region of Gujarat state, and have been successfully controlled the disease as well. Although the fruits have haematinic, anti-asthmatic and spasmolytic activity, systematic study which can identify possible mechanism and phytoconstituents of fruits of *Opuntia elatior* Mill. for such action is not yet to be found.

In the light of the above, the objectives of present study were

(i) To carry out qualitative and quantitative phytochemical analysis of fruits of *Opuntia elatior* Mill.

(ii) To screen and evaluate ethanopharmacological use of fruits of *Opuntia elatior* Mill. as haematinic, anti-asthmatic and spasmolytic agent using various animal model.

(iii) To screen and evaluate antimicrobial action of fruit peel of *Opuntia elatior* Mill.