Ethnobotany is a multidisciplinary science, dealing with the study of total natural and traditional interrelationships between man and plants (Jain, 2001). The ethnomedical information has contributed to healthcare world-wide. Ethnobotanical surveys are an important step in the identification, selection and development of therapeutic agents from medicinal plants which serve as a base for new compounds with active principles for phytochemical, pharmacological and clinical research. Many researchers use ethnobotanical information as the "clue to which plants are prime candidates for further screening and chemical analysis" (Farnsworth, 1984). A detailed ethnobotanical study may not only draw the attention of plant chemists and pharmacologists but also help to transmit and protect the knowledge of these putative plant remedies for future generation.

The earliest mention of medicinal use of plants and animals in human civilization could be traced back to the Vedic period. Each and every tribal/ethnic community has its own system of traditional medicine and they utilize the available natural resources around their habitats for various medicinal purposes. This traditional knowledge is handed down orally from one generation to the other through trial and error methods (Sinha, 1996). Hence, medicinal plants have traditionally occupied an important position in the socio-cultural, spiritual and health sector of rural and tribal people of India. The presence of diversified living ethnic groups and rich biological resources make India one of the richest countries with ethnobotanical knowledge.

Literature review revealed that ethnobotanical information have been documented from different parts of the world including India (Voeks, 1996, Noumi et al., 1999; Ballero et al., 2001; Udayan et al., 2005; Tiwari and Pande, 2006; Dabagar, 2006;
Collins et al., 2007; Humayun, 2007). In Karnataka, a few reports have documented ethnobotanical knowledge of certain areas (Bhandary et al., 1995, 1996; Kshirsagar and Singh, 2001; Harsha et al., 2002; 2005; Parinitha et al., 2004, 2005; Prakasha and Krishnappa, 2006; Prashantkumar and Vidhyasagar, 2008; Shivanna et al., 2008). A perusal of these reports suggest that ethno-medico-botanical survey is incomplete in parts of Karnataka whose traditional herbal healing knowledge is worth documenting. There are no previous records of a detailed documentation of ethno-medico-botanical knowledge from Shimoga district, which is one of the cultural centers in the southern part of Karnataka.

Investigations on phytochemical and pharmacological effects of traditional medicinal plants used by the tribes, ethnic groups or local communities have been conducted to a considerable extent (Samy et al., 2008; Auddy et al., 2003; Nayak et al., 2007; Umachigi et al., 2007). Secondary metabolites from medicinal plants have also served as models for the preparation of effective agents through semi-syntheses or lead-based total syntheses. Several life saving bioactive compounds such as atropine, reserpine, quinine, thiobromine, berberine, colchicine, digitoxin, digitalin, morphine, khellin, xanthotoxin, ephedrine, curcumin, hydrastine and strychnine extracted from plants are based on the study of ethnomedicine or indigenous system of medicine (Fabricant and Farnsworth, 2001).

Population pressure and other developmental activities are causing a great deal of habitat loss and species extinction in every part of the world. Today, biodiversity dependent rural communities are facing a serious threat because of the rapid loss of natural habitat and the over-exploitation of medicinal plants from the wild. As a result, several plant and animal species have become extinct and large number of others are facing various kinds of threats (Schultes, 1962). With the rapid industrialization of the
planet and the loss of ethnic cultures and customs, some of this information will disappear very soon. Consequently, there is an urgent need to record and preserve all information on plants used by different ethnic or tribal communities, living throughout the world, for various purposes before it is completely lost.

The present investigation was taken up to document phyto-medico-botanical knowledge of resident local/folk communities in Shimoga district of Karnataka. The main objectives of the present study were; to identify folk or local communities residing in Shimoga district and to document ailments affecting these communities and their domestic animals; to document detailed information on ethnoformulations, their components, plants and their part used, method of drug preparation, mode of application, dosage and duration; to collect details of each species, prepare herbaria and photographic documentation; statistical analysis of the data collected; to evaluate the efficacy of an important promising ethno-medicinal plant species in the study area for anti-microbial and wound healing properties and partial purification and characterization of the bioactive compound associated with wound healing property.

The study area, Shimoga district is situated in the heart of the Western Ghats region or Sahyadri range, which is one of the ‘hot-spots of biodiversity’ in India. A total of 140 villages in 7 taluks (20 villages in each taluk) were identified, mainly based on the information from experts or specialists in traditional healing medicine residing in these villages. The ethno-medicinal information of plants was collected through different interview techniques such as open ended, semi-structured and structured interview techniques (Martin, 1995; Cotton, 1997). Repeated enquires were made in the study area to confirm the information collected from them previously. During the field survey, vernacular names of plant species were confirmed with traditional healers of the study area. Plants were identified taxonomically using the standard flora/manuals (Saldanha and Nicolson, 1976; Yoganarasimhan et al., 1981; Gamble, 1986; Ramaswamy et al., 274
Voucher specimens were photographed and herbarium specimens were deposited at the Department of Applied Botany, Kuvempu University. The ethno-medicinal information collected during the field survey was analysed by statistical tools such as informant consensus factor (ICF), use-value (UV), fidelity level (FL), relative popularity level (RPL), rank order priority (ROP) and ethnobotanicity index (EI).

Based on the different statistical analytical methods and the prevalence of high consensus among healers, *Vallaris solanacea* an important ethnomedicinal plant in Shimoga district was selected for preliminary phytochemical studies and its wound healing activity. Leaf powder of *V. solanacea* were subjected to successive Soxhlet extraction with solvents - petroleum ether, chloroform and methanol. Crude plant extracts in solvent were screened for the presence of phytochemicals by following the procedures described by Harborne (1998). The chloroform fraction that showed significant wound healing was selected for further partial purification to determine the major group(s) of compound that might be present in the extract. Partially purified compound was subjected to advanced spectroscopic methods like FT-IR, LC-MS and $^1$H-NMR and confirmation of the possible major group of compound.

The efficacy of three organic solvent fractions of *V. solanacea* in wound healing was demonstrated using two wound model systems such as excision and dead space models. The antimicrobial activity of the crude plant extracts was carried out by agar well diffusion method (Perez et al., 1990).

Results of the study indicated that the local residents in Shimoga district belonged to different communities who practiced herbal medicine for both human and veterinary health care. Most of the herbal healers are male individuals rather than females. Majority of the respondents received primary education (49.75%), while the rest (46.34%) were illiterate persons. In the present study, a total of 263 medicinal plant species of 80 families used for the treatment of 80 different human and livestock ailments were
documented. The major ailments, according to informants, include gastro-intestinal and respiratory problems followed by skin infections, rheumatism, wound, snake bite/scorpion sting, diabetes and jaundice. This is confirmed by the large number of plant species used and also high use citations in the treatment of these ailments. Maximum number of medicinal plants (25) were used to cure skin allergies, followed by wound (21) and rheumatism (20) in humans. In case of veterinary ailments, 20 plant species were used for the treatment of foot and mouth disease, 17 species for wound and 15 for fracture and dislocation of bones.

The family Apocynaceae was represented by the highest number of species (12 species) which was followed by Fabaceae, Caesalpiniaceae, Lamiaceae, Asteraceae, Asclepiadaceae, Malvaceae, Mimosaceae and Euphorbiaceae, and others. Tree species were preferred by healers for most of the herbal drug preparations followed by herbs, shrubs, and climbers. They believed that wild plants are more efficacious than their cultivated counter parts. Leaf and root the most commonly used plant parts followed by bark, fruit, seed, flower, bulb, rhizome, and others. Leaf was also the preferred plant part in most of the other ethnobotanical studies around the world (Yieneger et al., 2008; Raghupathy et al., 2009). Herbal remedies are in the form of paste and juice followed by decoction, ash, massage oil, latex/sap/exudate and raw. The mode of preparation is by grinding, pounding, crushing, or boiling. Majority of herbal remedy (65%) contained freshly harvested plant parts, while 20% contained quick dried and 15% dried and stored.

Most remedies were administered orally for relieving asthma, diabetes, jaundice, cough, cold, typhoid, acidity, digestive problems, kidney stones and menstrual problems. Skin infections, rheumatism, bone fracture, crack heel and wounds were treated by application with paste, ointment or oil. Nasal inhalation or fumigation was recommended for relieving head-ache and fever. The dosage of drug always depended on the age and physical appearance of the patient and also type or severity of illness. Medicinal plant
preparations were measured in a small cup, jug or teaspoon or as handful. For wounds and some skin infection, the remedy was mostly given until cure. For ailments like diabetes, jaundice, paralysis, bone fracture, cardiac problems or rheumatic pain, treatment period lasted for 15 days or one month. Traditional healers used water as the main solvent in most of the formulation. Milk is also the preferred vehicle in most of the formulation. Milk, honey, butter-milk, curds, rice-washed water, jaggery, sugar candy, ghee, lemon juice and sugar were used as additives. Diseases were diagnosed by visual inspection and discussion with the patient.

In Shimoga district, as many as 54 ethnoformulations involving 70 plant species are new claims, being exclusively used for the treatment of specific ailments. Some of the noteworthy observations documented in the present study but not reported by earlier workers for such purposes are *Clematis gouriana* used to treat asthma and ulcer, *Cassia fistula* for acidity, *Cardiospermum halicacabum* for children cough, *Emilia sonchifolia* to treat leprosy, *Embelia ribes* and *Withania somnifera* in combination for paralysis, *Senna occidentalis* for verrucosis, *Ruta graveolens* for typhoid, *Elephantopus scaber* for treating diabetes, *Lobelia nicotianaeefolia* for throat pain, *Vateria indica* for dysentery, *Terminalia paniculata* for menstrual disorders, *Ficus asperima* and *Vitex altissima* in combination for skin allergies, *Tridax procumbens* to remove ectoparasites, *Biophytum sensitivum* for piles, *Calycopteris floribunda* for wound caused by burn, and *Vitex negundo* for sore nose.

The ethno-botanical data of Shimoga district were analysed by informant consensus factor (ICF). The present study revealed a high level of consensus among the local community of Shimoga district in the treatment of different ailments. The average informant consensus value of all disease categories was 0.52 indicating a moderate level of informant consensus. Traditional herbal healers in Shimoga district agreed more in the treatment of liver complaints (ICF=0.82) and different types of wounds (0.81). The maximum number of medicinal plants (76 species) used in general health category had the lowest ICF value (0.19).

The use-value was used to evaluate the relative importance of each medicinal plant species based on its usage among informants. In Shimoga district, only ten plant species showed high use value ranging from 0.10 to 0.36. These are *Tinospora cordifolia*, *Tabernaemontana alternifolia*, *Justicia adhatoda*, *Syzigium cumini*, *Hibiscus rosa-sinensis*, *Ruta graveolens*, *Lantana camara*, *Leucas aspera*, *Phyllanthus amarus*, *Terminalia bellirica* and *Vallaris solanacea*.

The analysis of data by fidelity level (FL) revealed that the plant species used for a specific disease in the study area varied between 13.6 and 100%. The maximum FL (100%) was expressed by *Cyclea peltata* for dysentery, *Memecylon malabaricum* and *M. umbellatum* for herpes, *Phyllanthus amarus* for jaundice, *Diospyros montana* for jaundice, *Clematis gouriana* for head-ache, *Calycopteris floribunda* for burn wound, *Connarbus wightii* for verrucosis and *Cryptolepis buchanani* for skin allergies, This indicated the 100% choice of most healers for treating such diseases.

The data analysis by relative popularity level (RPL) revealed that only 11 plant species have high relative popularity level of 1.00. Some of the plant species having high RPL of 1.0 in Shimoga district include *Adhatoda zeylanica*, *Careya arborea*, *Cassia fistula*, *Cyclea peltata*, *Ervatamia heyneana*, *Ficus racemosa*, *Gymnema sylvestre*, *Hibiscus rosa-sinensis*, *Phyllanthus amarus*, *Tinospora cordifolia* and *Vallaris*.
solanacea. Results indicated that the number of popular plants (10.18%) is considerably smaller than that of the less popular (89.81%).

The analysis by rank-order priority (ROP) revealed that only 13 plant species were most preferable and highly ranked species in Shimoga district and have ROP above 50. The plant species with high ROP values were identified to have the most effective healing properties. For example, Phyllanthus amarus, Gymnema sylvestre, Ervatamia heyneana, Vallaris solanacea, Memecylon malabaricum, Cyclea peltata, Alstonia scholaris and Memecylon umbellatum.

The ethnobotanicity index gives an idea of the importance of medicinal plants in a region. The ethnobotanicity index (EI) of Shimoga district is 30.14% for medicinal plants which means that 30.14% of plants find application in folk medicine in Shimoga district. This moderate level of EI is also an indication of alarm cautioning the fast decline of utility of knowledge of medicinal plants in Shimoga district. However, the present value is higher than that of the regions in other countries (Blanco et al., 1999; Agelet and Valles, 2001, 2003; Camejo-Rodrigues et al., 2003; Akerreta et al., 2007).

The present investigation indicated that, Vallaris solanacea is a popular ethnomedicinal plant in Shimoga district used in bone fracture and wound healing. Hence the plant was selected for phytochemical and pharmacological studies. The preliminary phytochemical analysis of the crude leaf extracts of V. solanacea by qualitative study (Harborne, 1984) showed that petroleum ether contained phenols and glycosides, chloroform contained flavonoids and steroids, methanol extracts contained flavonoids, saponins and steroids.

Results of the study on antimicrobial activity revealed that petroleum ether, chloroform and methanol fractions of V. solanacea had no effect on the growth of four fungal species - Fusarium oxysporum, Alternaria alternata, Aspergillus niger and Candida albicans. The chloroform fraction showed inhibition zone against...
Summary

Staphylococcus aureus and Pseudomonas aeruginosa, but was ineffective to Xanthomonas campestris, P. fluorescens and Escherichia coli. The maximum (16 mm) inhibition to E. coli and minimum (12 mm) inhibition to X. campestris was produced by methanol fraction and moderate to Staphylococcus aureus (13 mm) but, there was no inhibition against P. fluorescens and P. aeruginosa. The petroleum ether fraction caused mild inhibition (11 mm) to Xanthomonas campestris and was ineffective to Pseduomonas aeruginosa, P. fluorescens, E. coli and Staphylococcus aureus. In comparison to all the fractions of V. solanacea, the standard antibiotics produced prominent zone of inhibition against the respective test organisms.

In the present investigation, two wound models such as excision and dead space using rats were used to evaluate the wound healing activity. Both models indicated significant wound healing activity with the leaf extract of V. solanacea. In the excision wound model, chloroform extract showed significant reduction in wound area and faster rate of epithelialization as compared to petroleum ether and methanol extracts. The complete closure of wound area and epithelialization in both standard and chloroform extract treated groups was observed on day 17. On the other hand, the complete wound healing due to methanol and petroleum ether fractions occurred on 19th and 20th days after wounding. In control animals, complete healing occurred only on 22nd day.

In the dead space model, the animals treated with chloroform fraction showed significant increase in the wet and dry weight of granulation tissue when compared to that in control group. The increase in weight was moderate in petroleum ether and methanol fraction treated animals. The control group animals showed incomplete wound healing and also low gain in granulation tissue weight. Histologically, the chloroform or petroleum ether extracts treated animals showed significantly increased and well-organized bands of collagen fibres and fibroblast cells. In control group, low level of
collagen formation, epithelialization, and fibrosis, less blood vessels, and more number of macrophages was observed.

The chloroform extract of \textit{V. solanacea} has been shown to possess a significant wound healing activity as evident by results of two wound model systems. Results of the present study supported the views of herbalists of Hosanagara taluk of Shimoga district that \textit{V. solanacea} in folk medicine could be used for the treatment of wounds. Hence, chloroform extract was subjected to partial purification to determine the major group of compound that might be present in this extract. The partially purified compound was subjected to spectroscopic methods such as FT-IR, LCMS and \textsuperscript{1}H-NMR. The spectral data suggested that chloroform extract might contain steroids as the major compound which helped in wound healing and with antimicrobial activity.

The present study revealed that the traditional herbal healers of different communities in Shimoga district have very good knowledge of medicinal plants, which could be used for treating a variety of diseases and disorders of humans as well as veterinary animals. Documenting of the traditional knowledge of treatment with herbal formulations by folk herbal healers will help in the utilization of the locally available alternative healthcare systems in the larger interest of the society. A large number of ethnoformulations used for different ailments in the study area are new and note-worthy. The phytochemical analysis and pharmacological investigations of ethnomedicinally important plants would help to develop novel drug(s) to treat chronic human ailments. The present investigation helped in the establishment of antimicrobial and wound healing properties an important ethnomedicinal plant - \textit{Vallaris solanacea} in the study area.