II. REVIEW OF LITERATURE

2.1 Ethno veterinary Practices

The study of ethno-veterinary practices is a growing area of inter-disciplinary research having immense potential to understand various nuances of folk knowledge on domesticated animals.

According to McCorkle, (1986), ethno veterinary practices cover people’s knowledge, skills, methods, practices, and beliefs about the care of their animals.

The majority of ethno veterinary practices are focused towards chronic conditions as stated by Andrews et al.(2004).

2.1.1 Medicinal Plants and Herbal Therapy

Medicinal plants, since times immemorial, have been used in virtually all cultures as a source of medicine. The widespread use of herbal remedies and healthcare preparations, as those described in ancient texts such as the Vedas and the Bible, and obtained from commonly used traditional herbs and medicinal plants, has been traced to the occurrence of natural products with medicinal properties.

The use of traditional medicine and medicinal plants in most developing countries, as a normative basis for the maintenance of good health, has been widely observed (UNESCO, 1996). Furthermore, an increasing reliance on the use of medicinal plants in the industrialised societies has been traced to the extraction and development of several drugs and chemotherapeutics from these plants as well as from traditionally used rural herbal remedies (UNESCO, 1998). Moreover, in these societies, herbal remedies have become more popular in the treatment of minor ailments, and also on account of the increasing costs of personal health
maintenance. Indeed, the market and public demand has been so great that there is a great risk that many medicinal plants today, face either extinction or loss of genetic diversity.

The rich and diversified flora of India provides a most valuable storehouse of medicinal plants. The curative properties of herbs have long been known and are documented in ancient manuscripts, such as the Sanskrit Rig Veda, Garuda Purana and Agni Purana (Holland, 1994; Priyadarsan, 1991).

According to Sebastine (1984), these treatises focus on the potential of plants and herbs to cure human ailments and diseases. But the botanical wealth of India also offers the people who tend livestock a rich reservoir which they can tap in their efforts to treat the diseases and ailments of the animals they have for so long depended upon.

It is opined that Indian communities are traditionally rural in nature and a great deal of knowledge in this field has been accumulated over the years. There are no ancient manuscripts comparable to those knowledge mentioned above, but scientists are now documenting the various ethno veterinary practices based on informal interviews and discussions (De 1969; Sebastine and Bhandari 1984; Maheswari et al., 1986; Bothakar and Reddy Sudarsanam 1987).

2.1.2 Medicinal Plants in India

India is one of the world’s 12 regions having the largest bio-diversity. It has 45,000 plant species, of which 15,000 to 20,000 species possess proven medicinal value (Krishna Kumar, 1996). The Indian Council of Agricultural Research (ICAR) in the year 2000 collected and recorded 595 veterinary traditions from different sources (Swarup and Patra, 2005). About 48 of them were recommended for scientific validation, and some have shown therapeutic and ameliorative
potential. In another work on “Identification and evaluation of medicinal plants for the control of parasitic diseases in livestock, 158 plants have been catalogued and 50 have been evaluated for anti-parasitic activity (Anonymous, 2004).

In ancient cultures, people developed their own herbal pharmacopoeias based on information gained through experience and today’s scientific pharmacopoeia much of the information on scientific medicine is derived from those herbal pharmacopoeias (Kim, 2005). Before the advent of Organic Chemistry in the 19th century, 80% of all medicines were obtained from plant materials. Modern pharmacopoeias contain at least 25% of drugs derived from plants that are synthetic analogues built on prototype compounds isolated from plants (Kim, 2005). Medicinal plants are integral component of EVM. Medicinal plants used by traditional healers are mostly found to be effective (McCorkle and Green, 1998).

Scientists are now documenting various ethno-veterinary practices based on plant drugs (Takhar, 2004). Most of ethnobotanical veterinary practices have been substituted by current veterinary treatments for contagious diseases in many countries but still for certain gastrointestinal, respiratory, skin, internal/external parasites, reproductive problems, wounds and inflammation, medicinal plants are used and efforts for making the basis for the first national databank for ethno-veterinary botany are in progress in Europe. Information collected is based on folk botanical literature since 1950 till now, earlier publications are cited which are the addition of preliminary unpublished data obtained by interviews in field from different regions of Italy (Viegi et al., 2003).
2.1.3 Plant parts and methods of preparation of herbal medicine:

Sinha parol et al. (2012) reported that plants are one of the most important sources of medicines. The medicinal plants are rich in secondary metabolites which are potential sources of drugs and essential oils of therapeutic importance. The important advantages claimed for therapeutic uses of medicinal plants in various ailments are their safety besides being economical, effective and bioavailable.

2.1.3.1 Methods of preparation of herbal medicine

Methods of preparation of traditional medicines varies according to the active ingredient to be extracted, the route of administration, and the medical intent.

For preparation of drugs, parts of the plants that are mostly utilized are roots, barks, wood, leaves, stems, flowers, fruits, juices, resins, latex, grains, buds, bulbs and seeds (Nfi et al., 2001; Abbas et al., 2002; Giday et al., 2003; Ole-Miaron, 2003; Viegi et al., 2003; Jabbar et al., 2006a; Dilshad et al., 2008).

As per the views of Abbas et al. (2002), common methods of extraction of drug is through grinding or crushing in wooden or stone-made mortar and pestle, and soaking or boiling different parts of plants. Arbitrary quantities of carrier are added to dilute or reduce relative potency of the drug. Mostly water is added to dilute the juice.

Butter or petroleum jelly is added as base in certain ointments. Sometimes burnt leaves for topical application are used (Tabuti et al., 2003). Healers in Africa and in other parts of the world prepare infusions, decoctions, powder, drops, fumes, pastes and ointments from plants, animals, minerals and other substances
Sometimes, they administer fresh leaves down the throat of animal (Abbas et al., 2002).

2.1.3.2 Dosage of herbal medicine

According to Lans et al., (2000), a general perception among the respondents is that what works for someone, does not work for others and each individual has to work out their own dose.

Lack of precision in dose determination has been noted in many studies. The doses are often measured as a handful (50-60g), a bottleful (250ml) and sometimes using conventional weighing balances (Bakhiet and Adam, 1995; Longuefosse and Nossin, 1996 cited by Farooq et al., 2008).

Imprecise and non-standardized dosages are subjected to criticism by the veterinarians as stated by Niwa et al., (1991)

According to Kudi,(2003),the majority of EVM ‘specialists’ use ingredients alone or with a vehicle for administration and usage of carrier in EVM practices involves arbitrary quantities of the carrier. Carrier might dilute the drug or reduce its relative potency (Alawa et al., 2002; Jabbar et al., 2006a).

Alawa et al.( 2002) reported that use of wood ash, kaolin and potassium as a lick, that has no medicinal value but improves performance through their effect on feed efficiency.

2.1.3.3 Route of drug administration

Medicine is mostly administered to the animals orally as decoctions, liquid in that the plants have been steeped, vaccination, suppositories, through smoke, vapours, massage, intra nasally or applied topically on the skin or as a bathe in skin
problems as reported by McCorkle and Mathias-Mundy (1992); Lans et al. (2000); Tabuti et al. (2003); Muhammad et al. (2005) and Dilshad et al. (2008).

2.1.4 Traditional methods of disease diagnosis

Abo-Shehada et al. (1999) reported that traditional methods of disease diagnosis in livestock are found to be fairly accurate in many studies. A study conducted in Jordan on Surra found the traditional diagnostic method was accurate that 100% of the camels infected with Trypanosoma evansi (Surra) stared at the sun. Another traditional diagnostic method for Surra was termed as Sand-ball test.

Muhammad et al. (2005) reported that in India, traditional method of diagnosis of Surra was termed as Hair-stick test. In this test, hairs were pulled out from suspected animal’s tail and allowed to stick the hair roots on the hand facing downwards. The animals were considered healthy if the hairs stick to the hand, otherwise they were diagnosed as infected.

2.1.5 Ethno Veterinary Medicine

According to the views of Mathias-Mundy and McCorkle (1989), Ethno-veterinary medicine has emerged as a challenging field in more recent times that promises to benefit rural and peri-urban stock raisers, not just in the developing countries, but everywhere by virtue of the “generation or regeneration” of certain animal health technologies.

Ethno-veterinary Medicine is used for the maintenance of good animal health in developing countries (Kudi, 2003). According to an estimate over 80% of the developing world’s population use the traditional medicine for treatment of animal diseases (Shaikh and Hatcher, 2005).
As mentioned by Andrews et al. (2004), in addition to the increasing usage of local knowledge, there are several other reasons which have contributed to the recent growth in interest in ethno veterinary medicine at farm, local, national and international levels. Antibiotics, acaricides and anthelmintics can be dramatically effective when affordable and used correctly. However, the rising cost of these medicines and its consequences is now a major issue.

Ethno veterinary medicine covers people’s knowledge, skills, methods, practices and beliefs about the care of their animals (McCorkle 1986). According to him, Ethno veterinary medicine is often mean to usage of medicinal herbs. Ethno veterinary medicine have a controversy with scientific or ‘allopathic’ veterinary medicine taught at universities. Both are dynamic and changing. Like scientific veterinary medicine, ethno veterinary practices have been developed through trial-and-error and deliberate experimentation. But ethno veterinary medicine is developed by farmers in fields and barns, rather than by scientists in laboratories and clinics. It is less systematic and less formalized, and is usually transferred by word of mouth rather than by scientific documentation of results.

There are approaches for the identification and validation of anthelmintic effect of medicinal herbs used in ethno veterinary medicine.

Krishna Kumar, (1996) reported that in South India especially in Kerala, many livestock owners who are poor and those live in remote areas use ethno veterinary medicine for the primary health care of their animals. It was found that the animal health care in Kerala was influenced by Mrigayurveda, the animal component of Ayurveda from the ancient system of Indian medicine

The practice of traditional medicine is widespread in China, India, Japan, Pakistan, Sri Lanka and Thailand. In China about 40% of the total medicinal
consumption is attributed to traditional tribal medicines. Herbal medicines make use of legumes encountered in the *Caesalpiniaeae*, the *Fabaceae*, and the *Mimosaceae*. In the mid-90s, it is estimated that receipts of more than US$2.5 billion have resulted from the sale of herbal medicine. In Japan, herbal preparations are more in demand than mainstream pharmaceutical products. Africa is a rich source of medicinal plants. Perhaps, the best known species is *Phytolacca dodecandra*. Extracts of the plant, commonly known as end, are used as an effective molluscicide to control schistosomiasis (Lemma, 1991).

*Hemidesmus indicus* (L) R.Br. (family: Asclepiadaceae) is a twining shrub which has been used as folk medicine and as ingredient in Ayurvedic and Unani preparations against diseases of blood, inflammation, diarrhoea, respiratory disorders, skin diseases, syphilis, fever, bronchitis, asthma, eye diseases, kidney and urinary disorders, loss of appetite, burning sensation and rheumatism etc. (Vaidya and Kulkarni, 1991; Nadkarni, 1989). It has also been used in combination with other drugs for snake bite (Kirthikar and Basu, 1935; Mors, 1991).

Recently, this plant was used to treat viper venom (haemotoxic) induced lethality (Alam et al., 1996) and against hypercholesterolaemia in hyperlipidaemic rats (Bopanna et al., 1997).

### 2.1.5.1 Ancient origin of Ethno Veterinary Medicine

The veterinary religious texts of ancient times indicate quite remarkable rational basis of the healing art of that time. Veterinarians were delivering services as early as 1800 B.C. during the reign of King Hammurabi of Babylon. The famous “Code of Hammurabi” in that era laid out laws concerning the fees veterinarians could charge for treatment of cattle and donkeys (Schwabe, 1984).
Creation of animal hospitals during the reign of King Ashoka between 269 and 232 B.C. in the Rock Edict II suggests that the first known veterinary hospitals of the world (Somvanshi, 2006). The ‘Edicts of Ashoka’ show his keen interest in animal welfare. He arranged the cultivation of herbal medicines for animals in his empire and adjacent kingdom. Considerable knowledge available about different animal species, grazing lands, rules of meat science, livestock products like skin and fur, and veterinary jurisprudence flourished during the great Hindu kings of the Gupta period up to 800 A.D. before Islamic followers invaded India.

It is worth to mention that the Indus Valley civilization is one of the foremost contributors in the history of development of veterinary science and animal husbandry (Somvanshi, 2006). Later on, China, Egypt and Arabia developed into the centres of veterinary practices. Veterinary schools of those times tried to differentiate between quackery and rational explanations of diseases and their treatment (Schillhorn vanVeen, 1997).

2.1.5.2 Aloe vera

*Aloe vera* (L), a member of the family *Liliceae*, is a popular perennial succulent plant that is cactuslike in its characteristics (Tyler, 1993). The plant has a long history as a multipurpose folk remedy (Reynolds and Dweck, 1999), and has been associated with myth, magic and medicine since pre-biblical times (Balter, 1992). Essentially two products can be extracted from *A. vera* leaves; the clear gel that forms naturally in the leaf’s hollow interior is used to treat skin irritation, and it is an active ingredient in hundreds of skin lotions and soaps (Grindlay and Reynolds, 1986; Kemper and Chiou, 1999; Foster, 2004; Moody et al., 2004). The resin canal cells found in thick leaf epidermis produce a yellow juice (latex) that is used as a laxative and disinfectant (Tyler, 1993; Foster, 2004), and in experimental
and folklore medicine for liver complaints, piles, emetic, anti-pyretic, enlarged spleen, cooling agent, skin diseases, tuberculosis and fungal diseases.

2.1.5.3 Garlic (Allium sativum)

Garlic is primarily used as an herb to enhance many food dishes in various cultures, many compounds can be found in its bulbs. It contains vitamins A and C, potassium, phosphorous, selenium, and a number of amino acids (Mayo, 1999). Most important are the over 75 sulfur containing compounds including alliin (S-allyl-Lcysteine sulfoxide). If the bulbs are ground or crushed, alliin is transformed into allicin (diallyldisulfide S-oxide), which the typical garlic odor is attributed. A broad spectrum of antibacterial properties is associated with allicin (Dubick, 1986).

Garlic is also able to stimulate the immune system's macrophages, white blood cells that destroy foreign organisms. It also increases the activity of T-helper cells, and can be used to treat upper respiratory viral infections because of its ability to clear mucous from lungs (Holladay, 1995), and help asthma patients (Grieve, 1995). During World war I, garlic was used as an antiseptic for wounds (Grieve, 1995) and to treat typhus and dysentery. Researchers have found that garlic blocks the action of certain enzymes that help infectious microbes survive in host tissue (Mayo, 1999).

It also stimulates the production of the liver's detoxifying enzymes that neutralize carcinogens (Holladay, 1995). Chemical studies have shown diallyl sulfide to be the major active compound of garlic (Hun, 1993).
2.1.5.4 *Cinnamomum sulphuratum* (Ilavangam)

The bark and the leaves of *Cinnamomum* species (Family Lauraceae) are commonly used as spices in home kitchens and their distilled essential oils or synthetic analogs are used as flavoring agent in the food and beverage industry (Jham et al. 2005). According to Maridass and Victor, (2008) seven *Cinnamomum* species such as *C. walaiairense*, *C. trivancoricum* and *C. malabatrum*, *C. riparium*, *C. sulphuratum*, *C. filipedicellatum* and *C. wightii* were used for treating wounds, fever, intestinal worms, headaches and menstrual problems. Although traditionally known, some recent scientific studies have shown antimicrobial activity of essential oils of *Cinnamomum cassia*, *C. osmophloeum* and *C. zeylanicum* (Tiwari and Tiwari, 1997; Ferhout et al. 1999; Mastura et al. 1999; Chang et al. 2001).

2.1.5.5 *Murraya koenigii* (Curry Leaf)

Curry leaf (*Murraya koenigii*) is an important leafy vegetable. Its leaves are widely used in Indian cookery for flavouring foodstuffs. The leaves have a slightly pungent, bitter and feebly acidic taste, and they retain their flavour and other qualities even after drying. Curry leaf is also used in many of the Indian ayurvedic and unani prescriptions.

The various notable pharmacological activities of the plant such as activity on heart, anti diabetic and cholesterol reducing property, antimicrobial activity, antiulcer activity, antioxidative property, cytotoxic activity, anti diarrhea activity, phagocytic activity. The chemical composition of the fresh leaves of *Murraya koenigii* consists of volatile oil. Carbazole alkaloids and triterpene have been isolated from stem bark and roots of *Murraya koenigii*. (Sinha parol et al., 2012)
The chemical composition of the volatile oil of the fresh leaves of *Murraya koenigii* consisting of 97.4% of the oil were identified. The major constituents identified were alpha-piJene (51.7%), sabinene (10.5%), beta-pinene (9.8%), beta-caryophyllene (5.5%), limonene (5.4%), bomyl acetate (1.8%), terpinen-4-ol (1.3%), gamma-terpinene (1.2%) and alpha-humulene (1.2%). (Jasim Uddin Chowdhury et al.2008)

2.1.5.6 *Phyllanthus niruri* (Keezha nelli)

The species *Phyllanthus niruri* (Linn.) also known as *P. amarus* (Hindi-Bhumi amlaki, English-Stone Breaker, Shatter stone, Kannada-Nela nell) is an important plant of Indian Ayurvedic system of medicine. Phytochemical studies have shown the presence of many valuable compounds such as lignans, flavonoids, hydrolysable tannins (ellagitannins), polyphenols, triterpenes, sterols and alkaloids. The extracts and the compounds isolated from *P. amarus* show a wide spectrum of pharmacological activities including antiviral, antibacterial, antiplasmodial, anti-inflammatory, antimalarial, antimicrobial, anticancer, antidiabetic, hypolipidemic, antioxidant, hepatoprotective nephroprotective and diuretic properties (Patel et al.2011)

2.1.5.7 *Ocimum sanctum* (Tulsi)

According to Sirkar (1989), in Ayurveda, *Tulsi* (*Ocimum sanctum* L.) has been well documented for its therapeutic potentials and described as Dashemani Shwasaharni (antiasthmatic) and anti-kaphic drugs (Kaphaghna) and he traditional medical practitioners in India have been widely using this medicinal plant for management of various disease conditions since ancient time.
As reported by Sen (1993), in the last few decades, several studies have been carried out by Indian scientists and researchers to suggest the role of essential oils & eugenol which is a phenolic compound and major constituent of essential oils extracted from different parts of Tulsi plant.

According to Nagarjun et al (1989), aqueous decoction of whole plant lowers the blood sugar (glucose) level and is said to control diabetes mellitus. Paste of Tulsi leaves are found effective in the treatment of ring-worm and other skin diseases. Tulsi has been also recommended for use as antidote for dog bite, scorpion bite and insect bite in traditional system of medicine. The fresh leaves and flower tops of Ocimum sanctum L. have been used as antispasmodic agent as smooth muscle relaxant.

2.1.5.8 *Trigonella foenum*

According to Sebastian and Thampan (2007), in India, *Trigonella foenum* (fenugreek) is commonly consumed as a condiment and used medicinally as a galactagogue by nursing mothers to increase inadequate breast milk supply. Studies have shown that fenugreek use was associated with increases in milk production of as much as 900 per cent. Several studies have also shown the anticancer properties of this herbal plant. The chemopreventive aspects and the potential protective effect of fenugreek seeds against 7, 12-dimethylbenz[ a] anthracene (DMBA) in rats has been reported.

2.1.5.9 *Cuminum cyminum*

Sebastine, (1984) reported that Cumin has three primary medicinal uses: to treat paleness of the face, to relieve indigestion and digestive gas, and to relieve minor aches and pains. It’s essential oils can also be used as a sedative, and when ground into a paste, it can be used to help heal wounds, cuts, and scrapes. Other
health benefits of cumin include high concentrations of iron, manganese, and other essential minerals.

2.1.5.10 *Azadirachta indica* (Neem)

In antiviral assay conducted by Galhardi *et al.* (2012), ethanolic extract of *Azadirachta indica* resulted in potent antiviral activity against FMDV at concentration (6-25 µg/ml) as CSP was above 50% at this range. *A.indica* showed anti-FMDV activity at concentration range of 12 – 100 µg / ml and 50 – 200 µg / ml respectively. Ethanolic AI leaves extract contains polysaccharides as active antiviral against poliovirus type-1. In another study Saha *et al.* (2010) reported that pecticarabinogalactan is a component derivative in Neem plant responsible for antiviral potential against bovine herpes type-1 virus. *Moringa oleifera* alcoholic leaves extract had significant antiviral activity against Equine Herpes virus type 1 (Meenakshi and Garg, 2005)

2.1.5.10.1 Anti viral properties of *Azadirachta indica*

Research indicates that Neem is a powerful tool to fight viral infections, including the herpes virus. Neem may be applied topically to any areas of the body during an outbreak or just prior, when stress is high and we begin to get that ‘feeling’ that often occurs just before an outbreak. To speed relief, one may also take the oral supplements, such as Neem leaf capsules.

According to Schmutterer, (1992), tests in Germany show that neem extracts are toxic to the herpes virus and can quickly heal cold sores. There has been a scientific study at Johns Hopkins University in 1997 where researchers tested the effect of neem against the herpes simplex virus-2, and found it "provided significant protection".
The scientists haven't been able to exactly figure out how it works, but neem seems to make it difficult for viruses to reproduce. This means the impact of any viral infection will be a lot less. Neem also boosts the immune system and that also helps to fight off the virus. It definitely works.

One of the first modern reports of neem being used as a medicinal herb focuses on the use of a neem leaf extract as an effective antiviral published in a 1969 article in the Indian Journal of Medical Research. Nearly 20 years later, research at Johns Hopkins University in Baltimore showed that neem "provided significant protection" against the herpes simplex virus-2 in mice infected with the highly infectious virus.

The antiviral and virucidal effect of neem leaves extract was studied to determine its activity against the Coxsackie B group of viruses. Neem inhibited the replication of six types of Coxsackie virus B. Observations of virus inactivation and population reduction in the experiment suggested that neem was most effective against Coxsackie virus B-4 early in its replicative cycle. Neem’s rich chemical constitution of flavonoids, triterpenoids and their glycosides are believed by the researchers to be responsible for the herb’s antiviral potency.

According to the reports of Rao, (1969), Singh and Sastry, (1981) and Saxena, (1985), Neem is one of just a few known anti-viral agents. In a study on neem's effectiveness as an anti-viral agent, neem seemed to interact with the surface of cells to prevent infection by the virus thereby inhibiting multiplication of the virus (Rai and Sethi, 1972). Similar results have been observed in studies of other viral pathogens indicating a unique property of neem to prevent viral disease.
2.1.5.11 Aqueous Poly herbal extract

Ayurveda extensively uses plant-derived poly herbal formulations for the treatment of various ailments after a careful study into the type of the disease as reported by (Sivarajan and Balachandra, 1996). Studies carried out in the past decade and a half have shown that poly herbal preparations like Liv. 52, Brahmarasayana, Narasimharasayana Swagandharasayana, Svavon (antimicrobial), Rumalaya (anti-arthritis, anti-inflammatory), Amrithaprasam, Abana and Triphala reduced radiation-induced damage in different study systems (Saini et al., 1984; Kumar et al., 1996; Jagetia et al., 2002, 2003).

2.1.6 Documentation of Ethno veterinary Practices

Both conventional and participatory methods have been used to document local knowledge in general and ethnoveterinary medicine in particular. Both approaches have their place, and their results can be complementary and possibly cross-validate each other. The documentation of local health traditions is aimed at systematic recording of Local Health Traditions and the resources used in it. The next step after documentation is Rapid Assessment of Local Health Traditions (RALHT). RALHT is aimed at selecting the best practices in household and health traditions and folk health traditions, for their promotion in primary health care, by means of a rapid assessment exercise. This form of assessment is termed ‘Rapid’ as it does not involve laboratory or clinical studies.
Research on poultry development was reoriented in India after independence to achieve the objective of accelerated development. Technologies are available in poultry production at a much faster rate than it was a decade back.

Although a lot sophisticated know-how is available on the research centers for augmenting production, most of the poultry farmers are still practicing outdated technologies in poultry production. This is primarily because there is considerable gap between the technology developed on the research farms and its application by the poultry farmers. As society develops, it becomes imperative that the technology necessary for sustainable development should be passed on to entrepreneurs. Transfer of evolved technology is an equally important task for boosting production and in turn the prosperity of the nation (Bhatnagar, 1987). Transfer of technology is a function of many factors, training being the crucial one (Charles and Charles, 1938; Lynton and Pareek, 1998).

Training has become a critical input in view of growing sophistication in sustainable poultry production. Taylor (1961) and Singh and Gill (1982) suggested that if the training is to be more effective the training needs have to be established prior to commencement of training programmes so that the subject matter of training could be determined on the basis of the needs of the trainees. So identification of the training needs becomes not only the first step but also the prime step in the formulation of training programmes which ultimately will be helpful in the acceptance of ethno veterinary practices in poultry farms.

In Tamil Nadu, Sustainable agriculture and Environmental Voluntary Action (SEVA) devoted its work in the documentation of Indigenous knowledge in the areas of agriculture, animal husbandry and grass root innovations (Vivekanandan, 2004)
2.1.6.1 Participatory tools for conducting the study

The formal methods of data collection were not suited to understand the problems of the poorest people living in rural communities. In response to this situation, alternative systems of inquiry were developed which is called as Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA). These systems are based on involvement of local people in defining their problems, analyzing them and finding the solution. So less informal survey methods started replacing formal survey methods. Less formal tools used in social anthropology and experience of indigenous knowledge systems began to merge with the field testing of informal interviewing, visualization and other methods (Chambers, 1994). Lack of budgets or insufficient funding for development projects were the main factors favoring the use of faster approaches than the time consuming anthropological fieldwork methods. Cost effective ways to learn and assess the problems of rural people and data collection led to development of Rapid Rural Appraisal and Participatory Appraisal Techniques (Catley, 1999).

This mixing of experiences and new learning involved many individuals and institutions and culminated in a land mark conference on RRA at the University of Khon Kaen, Thailand in 1985 (KKU, 1987; Chambers, 1994). In RRA usage development of networks of practitioners and the publication of the informal journal RRA Notes in 1988 by the International Institute for Environment and Development were used. Rapid Rural Appraisal is a collection of cost effective ways to learn about the researched situation, needs and initiatives of rural people and to collect relevant data for planning projects (Waters-Bayer and Bayer, 1994). Tools include interviewing, diagramming, scoring and ranking, mapping and visualization. Rapid Rural Appraisal aims for faster collection of better quality data and speedier analysis than given by conventional questionnaires (Waters-Bayer
and Bayer, 1994). Of these tools interviews were the most important group of methods because they were used alone but also complemented and formed the basis for other tools. Interviews were generally informal and semi-structured. An important part of RRA is triangulation (Waters-Bayer and Bayer, 1994) that means looking at things from various perspectives. The participatory methods put more emphasis on large sample sizes instead of use of complicated statistical methods. The objectives of the study should be considered when respondents are selected and interviewed.

In veterinary medicine, questionnaire surveys have been widely used to collect information. Important considerations while using questionnaire are target population and sampling method, questionnaire design, administration and quality control (Catley, 1999). Participatory Rural Appraisal is considered one of the popular and effective approaches to gather information in rural areas. This approach was developed in early 1990s with considerable shift in paradigm from top-down to bottom-up approach. The basic concept of PRA is to learn from rural people. Participatory Rural Appraisal represents a body of qualitative methods that emphasize the use of indigenous or local knowledge and that can be adapted to virtually any research situation.

In veterinary medicine, mostly questionnaires are used and points that should be considered include target population and sampling method, questionnaire design and quality control (Catley, 1999).

### 2.1.6.2 Training needs for sustainable Poultry development

Research on poultry development was reoriented in India after independence to achieve the objective of accelerated development. Technologies are available in poultry production at a much faster rate than it was a decade back.
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2.1.6.3 Acaricide effect of plant extracts

The application of plant extracts to livestock in order to repel or kill ectoparasites is widespread in the developing world. The idea of cultivation of plants and low-cost extraction of active compounds as a local industry in developing countries has considerable appeal. There seems to be a prevailing view that plant extracts or botanicals are safer and cheaper to produce than synthetic products. It is clear from a brief examination of the literature that there are many botanical products that can kill ticks or inhibit oviposition. Chabra and Saxena
(1998) briefly reviewed the plants that have been shown to be effective in the control of ticks or mites in Indian traditional medicine.

Ticks are the major problem for livestock. Control of ticks with chemical acaricides has become difficult because of its diminishing efficiency due to resistance development. Toxicity and resistance problems of insecticides (Nolan, 1987) have directed research towards alternate control using plant products as acaricides.

The ethnoveterinary methods of tick control practised in western Ethiopia have been examined by a survey of farmers, followed by in vitro and in vivo testing of treatments that appeared to have potential (Regassa, 2000). Chungsamarnyart and Jansawan (2001) investigated the effect of aqueous and ethanol extractions of tamarind fruits, as well as of their chief organic acids (oxalic, malic, succinic, citric and tartaric acids) on engorged, adult *B. microplus*.

Plants that have been evaluated and shown some acaricidal properties include *Azadirachta indica* (Williams, 1993; Kalakumar *et al*., 2000) *Ocimum suave* (Mwangi *et al*., 1995b), *Gynandropsis gynandra* (Lwande *et al*., 1999), *Gutierrezia* spp. (Miller *et al*., 1995), custard seed oil (Kalakumar *et al*., 2000), *Commiphora erythraea* (Carroll *et al*., 1989), *Artocarpus altilis* (Williams, 1993), *Stylosanthes scabra* (Khudrathulla and Jagannath, 2000), *Tamarindus indicus* (Chungsamarnyart and Jansawan, 2001), peel oil of *Citrus* spp. (Chungsamarnyart and Jansawan, 1996), and *Stemona collinsae* (Jansawan *et al*., 1993).

In addition to acaricidal effects, certain plants have repellant activities against ticks and this can act as a “push strategy” to keep ticks away from pasture. Use of many grasses (Barros and Evans, 1989) and miscellaneous plants
(Dobrotvorskil et al., 1989) for the control of ticks has been reported. Ingredients of plants and herbs posses insecticidal growth inhibiting, antimoulting and repellant activities (Roy et al., 1996).

Khudrathulla and Jagannath (2000), reported that the methanolic extracts of *Stylosanthes Scabra* were effective against the ixodid ticks of animals. *Nicotiana tabacum* has been proved to be a potent ectoparasiticide when employed as an infusion or a decoction (Dasan et al., 1929). Viscous liquid form boiled castor oil plant (*Ricinus communis*) is used for the treatment of mange and ectoparasites (Peacock, 1996).

### 2.1.6.4 Coccidiostatic effect of plant extract on broilers

Farmers are constrained from controlling coccidiosis by the inhibitory high costs of drugs and the fragmented veterinary service provision as stated by Kusina et al, 2001 and the use of aloe vera is believed to be cheaper and reliable though there is no documented evidence to substantiate such a claim.

### 2.1.6.5 Anthelmintic properties of medicinal plants

Diseases caused by helminth parasites in livestock continue to be a major productivity constraint, especially in small ruminants in the tropics and subtropics (Perry et al., 2002). In the Developing world, the greatest impact of parasitic
diseases is in direct and potential productivity losses (Perry & Randolph, 1999). The greatest losses associated with nematode parasite infections are sub-clinical, and economic assessments show that financial costs of internal parasitism are enormous (Preston and Allonby, 1979; McLeod, 1995).

Nemathelminthes in which the class Nematoda (roundworms) is found. Some of the superfamilies of veterinary importance in the phylum include Ancylostomoidea, Ascaridoidea, Oxyuroidea, Rhabditoidea, Strongyloidea, and especially Trichostrongyloidea (Anderson, 1992). Direct and indirect losses due to nematode infections are estimated to be high (Preston and Allonby, 1979), and control of these parasites is therefore considered important.

Considerable research has shown that some plants not only affect the nutrition of animals, but also have antiparasitic effects (Waghorn and McNabb, 2003). In such a survey in Asia, 23 plants were identified as potential anthelmintics (Anonymous, 1994). Of these plants, six were claimed to have an anthelmintic effect on poultry parasites, 10 on parasites of pigs and 11 against ruminant parasites. Some plants, like Areca catechu, were claimed to have an effect on parasites of all host species (Anonymous, 1994).

The vast majority of studies investigating the effects of Condensed Tanins (CT) on GI nematode parasites, either in experimental or in grazing conditions, have been conducted using sheep (Niezen et al., 1996; Niezen et al., 1998; Molan et al., 2000; Athanasiadou et al., 2001; Waghorn and McNabb, 2003). Studies have also shown that CTs had an effect on GI parasite infections in goats (Kabasa, Opuda-Asibo and Ter Meulen, 2000; Kahiya, Mukaratirwa and Thamsborg, 2003; Paolini et al., 2003).
There is a shortage of good quality trials and documentation of selective toxicity of EVM (Ethno Veterinary Medicine) preparations against internal parasites (Tagboto and Towson, 2001). However, in a number of studies, the active ingredients have been purified and characterised from plant extracts. Examples include, Embelin extracted from Embelia schimperi, which was evaluated in vivo in mice and rats infected with the cestodes Hymenolepis microstoma and H. diminuta, and mice infected with the trematode Echinostoma caproni, and the nematode Heligmosomoides polygyrus. This compound was found to be effective in vivo against the cestodes but not against the other parasites (Bogh, Andreassen and Lemmich, 1996). Atanine, a quinolone alkaloid extracted from Evodia rutaecarpa dried fruits. In vitro tests demonstrated inhibition of motility of free-living stages of the trematode Schistoma mansoni, and against the nematodes C. elegans adult stage and larvae of Teladorsargia circumcincta (Perrett and Whitfield, 1995). This was tested in an in vitro assay against the adult parasites of the porcine roundworm Ascaris suum, displaying similar activity to synthetic anthelmintic mebendazole on contact of the parasite with the preparations (Villasenor et al., 2002). Mangiferin, a major polyphenol in the aqueous extract vimang acquired from Mangifera indica. The polyphenol and the aqueous extract were tested in an in vivo mouse model against enteric and parenteral stages of Trichinellaspiralis. Moderate effects were reported against the larval stages in the muscles but not against adult parasites (Garcia et al., 2003). Flavan-3-ols (the monomer units of CT), and their galloyl derivatives were evaluated in vitro on the viability of eggs, the development and the viability of the free living stages of the sheep nematode Trichostrongylus colubriformis. The flavan-3-ol was found to have an effect on egg hatching as well as the development of larvae (Molan et al., 2003).
Anthelmintic properties possibly could differ depending on the method of preparation, the part of the plant used (root, stem, bark, leaf, flower, etc.) as well as the growth habitat (Martin, McCorkle & Mathias, 2001). Consequently, it was decided to evaluate all of these factors, such as the different methods of extraction and different growth habitat for some plants tested, e.g. *Myrsine africana* leaves and bark, *Albizia anthelmintica* root and trunk bark and cold and hot extracts.

The methods used for preparing the various plants were specific to each plant. Some plants were administered as crude aqueous extracts, while others such as *A.indica* leaves were dispensed to animals without processing, and others such as *M.africana* and *R. melanophloeos* were administered to animals as milled preparations. For aqueous extracts, either a cold or hot method of extraction was carried out, depending on the method used by the traditional healers.

**2.1.6.6 Treatment for anoestrus conditions**

Study reveals that majority of the animals treated for anoestrus by feeding the jelly part of *Aloe vera* (*sottru katralai*) leaves for 30 days came to heat. Among the selected respondents, 90 per cent of them reported that this technology was found to be effective. This might be due to the uterine stimulant property of the *Aloe vera* leaves which increase the contraction rate of uterine muscles and induces heat (Asolkar et al.,1992). Regarding treatment of anoestrus by feeding the thick mucilage made from the whole fresh plant including root, stem, leaves, flowers and seeds of the *Pedalium murex* (yani nerungi) for 20 to 25 days, majority of the farmers (90 per cent ) experienced that the practice was very effective. This might be due to the constituents of *Pedalium murex* plant such as pedalitin, diosmetin, dinetin and mucilage which are used in spermatorrhoea, impotency, gonorrhoea and urino-genital disorders. The plant is also used as a diuretic (Anjaria *et al.*, 2002).
2.1.6.7 Treatment for wounds

Honey is applied to wounds as dressings and acts by drawing fluid into the wound thereby clearing dirt and infectious agents. This promotes healing (Porth, 1994; Yila, 2002).

2.1.7 Clinical Evaluation

Herbal medicine or ethno veterinary treatments are given, in most cases ‘to effect’ to achieve clinical improvement rather than complete elimination of the causative agent (Ibrahim, 1996).

Well-established, randomized clinical studies lead to the better acceptance of herbal medicines. Clinical studies are necessary to confirm the pharmacological effects of medicinal plants before they can be integrated into conventional medical practice. This would be especially true in case of some unrelated effects of therapy contributing to efficacy that may be difficult to measure pre-clinically. Well recorded case reports can contribute towards useful information at such times and put forward new hypothesis and stimulate further study (Morris, 1989).

The methods and guidelines used for clinical validation of modern medicines must be applied to herbal products even though the latter has a holistic approach to treatment. However, conventional concepts of clinical research design may be difficult to apply when using clinical research to evaluate various systems and practices of traditional medicine (WHO, 2000). Only a limited number of plants can be subjected to clinical trials. Hence, it is essential to undertake appropriate preclinical testing to shortlist plants for clinical evaluation. The main goals of the preclinical studies are to determine a drug's pharmacodynamics, pharmacokinetics and toxicity through animal studies.
2.1.7.1. Mastitis

Mastitis is a multi etiological complex disease which is defined as the inflammation of parenchyma of mammary gland of the milch animals which is characterized by physical, chemical and bacteriological changes in milk and subsequently pathological changes in the glandular tissue (Radostits et al., 2000).

According to Kennedy and Miller (1993), mastitis is expressed by tissue injury caused by tissue invasive or toxigenic organisms. The recent authors on mastitis concentrate on individual species of major mastitis and various aspects of treatment and its control (Kirk et al. 1994 and Saran, 1995).

2.1.7.1.1 Incidence of mastitis in dairy cows and Buffaloes

Sharma et al. (2004) reported 70.32% incidences of sub clinical mastitis in buffaloes, while Mani et al. (2003) reported 70.37% incidence of sub clinical mastitis in cows. Loss due to mastitis has been increased to Rs.6053.21 crore per annum in the year 2001 (Dua, 2001). Apart from the economic importance, it is also worthwhile to study in the context of public health.

2.1.7.1.2 Economic importance of mastitis

Mastitis is one of the diseases confronting the dairy farmers. Estimation of exact economic losses resulting from mastitis becomes an extremely difficult task due to many levels of infection and etiology. Losses due to mastitis is by reduced milk yield upto 70%, milk discard after treatment upto 9%, 7% losses due to
veterinary treatment expenditures and 14 % loss due to premature culling as reported by Bhikane and Kawitkar, (2000).

2.1.7.1.3 Treatment for Mastitis

A number of EVPs were reported for the prevention and treatment of mastitis. In a study conducted by Bullitta et al.(2007), *Allium sativum* L. was the most frequently used plant for the treatment of mastitis in bovine, bubaline and small ruminants. This plant has been reported in literature to be used for its antiseptic and vermifuge properties.

In a study conducted by Islam and Kashem (1999), *Linum usitatissimum* L. used for the treatment of mastitis and in Bangladesh it was reported to be used as galactagogue. Padmakumar (1997), concluded that single medicinal plant species is used for different purposes in various areas.

Plants were used for fomentation purpose to decrease udder inflammation. Similar type of practice with different species of plants has been reported in case of mastitis in camels in Saudi Arabia (Abbas et al., 2002).

Uncini-Manganelli et al., 2001 reported that, use of mud derived from mouse burrow on the infected udder of cattle and buffaloes is somewhat similar to the practice reported in Italy for treatment of mastitis in cattle and caprine where mixture of clay and vinegar applied on infected udder.

2.1.7.1.4 Aloe vera in the treatment of mastitis

For treatment of the mastitis, Coats et al.(1985) recommend injecting 20 to 60 cc of aloes (in gel or juice form) into the infected quarter at least once a day. The teat end must be sterilized before an injection because the aloes will carry all the filth with it into the teat, thus aggravating the situation. He reported that Aloes
helps to drain the infection, has anti-inflammatory properties and is a coagulant. It has a diuretic property also, which serves to soften the hardened udder. Once again, it is important to remember that the milk from cows treated this way cannot be put into the milk tank. Further her stated that Aloe is particularly indicated for treating udder injuries, which often leads to staphylococcal mastitis. Application of the aloes will quickly heal the tissue.

2.1.7.1.5 Evaluation of haematological parameters in mastitis

2.1.7.1.5.1 Erythrocyte count

Wiwanitkit, (2004) reported that erythrocyte and platelet indices provide clinical information on the underlying conditions of anaemia and thrombocytopenia in cows infected with mastitis.

2.1.7.1.5.2 Packed Cell Volume

According to Wiwanitkit, (2004), there were no changes in parameters like red blood cell count (RBC) and packed cell volume (PCV) in a cow suffering due to sub-clinical mastitis.

2.1.7.1.5.3 Haemoglobin Content

Normal haemoglobin content in cattle ranges between 8 to 15 g/dl as reported by Maxime (1985).

Normal haemoglobin content in cattle was $8.91 \times 10^3/\mu l$ as reported by Ferguson et al. (1945).

2.1.7.1.5.4 Total leucocyte count

Talmadge et al., (2004) declared that administration of Aloe vera and β-Glucan can be highly stimulative on haematological parameters including WBC.
Due to increased hematopoietic activity was associated with increased mRNA levels for hematopoietic cytokines.

2.1.7.1.5.5 Neutrophil count

According to Sordillo et al., (1997), Neutrophils form the first line of immunological defence against bacteria invading the bovine mammary gland and neutrophils cannot return from tissues to blood, and eventually meet their fate in the mammary glands.

According to Lascelles, (1979), the most effective system of udder defence against invading pathogens is the phagocytic activity of neutrophils. He stated that normally, these cells are present in milk in very low numbers, the predominating leucocytes in the milk. Neutrophil numbers, however, rapidly increase in the very earliest stages of infection.

The value of neutrophils in early infection was seen when unrestricted growth of bacteria occurred in the mammary gland of cows rendered neutropenic by the administration of anti-bovine leucocyte serum. Neutrophil recruitment within the mammary gland is likely to be triggered by the presence of bacteria and bacterial products, which stimulate the formation of endogenous inflammatory mediators. These mediators lead to a margination of neutrophils in capillary vessels, cause a relaxation of endothelial cell junctions and allow a diapedesis of the neutrophils into the surrounding subepithelial connective tissues (Lascelles, 1979).

Linzell, (1961), reported milk collects in the teat and lactiferous sinus regions and it is thought that neutrophils are attracted as far as the luminal surface of the two-cell-thick epithelium by a concentration gradient of chemotactic factors originating from the lumen of the gland.
2.1.7.1.5.6 Lymphocyte count

Yang et al. (1988) reported that in the peripheral blood there was a significant decrease in the percent and absolute number of B lymphocytes in mastitic cows as compared to normal cows. The percent T lymphocyte count in mastitic cows (71.2 +/- 7.1%) was slightly increased over that of normals (65.8 +/- 7.2%), although the absolute number of T lymphocytes was decreased in mastitic cows.

2.1.7.1.5.7 Eosinophil Count

In a study conducted by Diana Brezovan et al., (2010) with mastitis animals, he analysed the cases of normal and abnormal milk assays. The milk cytogram revealed the absence of eosinophil and basophil granulocytes.

2.1.7.1.5.8 Monocyte count

Park et al., (1992) stated that the blood monocytes become macrophages in the tissues and are the major cell type. During bacterial pathogenesis, macrophages serve to facilitate either innate or acquired immune responses. During lactation, the proportion of macrophages is highest (68%) in the early post-partum period and lowest (21%) in late lactation.

According to Mullan et al. (1985), stated that similar to neutrophils, the non-specific functions of macrophages are to phagocytise invading bacteria and destroy them with proteases and reactive oxygen species.

2.1.7.1.5.9 Basophil count

Diana Brezovan et al. (2010) conducted a study with mastitis animals and he analysed the cases of normal and abnormal milk assays. The milk cytogram revealed the absence of eosinophil and basophil granulocytes.
2.1.7.1.6 Serum Chemistry in Mastitis

2.1.7.1.6.1 Total Serum Protein

Tsenkova et al., (2001) obtained an increase of total serum protein and serum globulin from subclinical mastitis cows compared to healthy cows.

Pandey, (2005) reported that an increase in proteins and globulin in the blood of cows indicate an activation of immune response following infection of the mammary gland. These proteins are mainly serum albumin and immunoglobulins that are implicated in udder defense mechanisms. Immunoglobulin plays an important role in host immunity and inflammation, and there is a correlation between total serum protein (globulins and albumin) and somatic cells count in milk.

2.1.7.1.6.2 Serum Alanine amino transferase

Yuksel et al. (2009) conducted a study to measure the alanine transaminase (ALT) in the blood serum of cows with subclinical mastitis (SM). His results revealed that the serum ALT activities were 12.22 and 9.12 IU/litre in subclinically mastitic and control cows (p<0.05), respectively indicating increased activity of ALT in subclinically mastitic cows. He suggested that alanine transaminase activities in the blood can be used as additional diagnostic tests when determining subclinical mastitis in dairy cows.

2.1.7.1.6.3 Serum Aspartate amino transferase

In a study conducted by Kitchen et al. (1970) the results indicated an increase in the activity of AST with the increase in severity of mastitis. The statistical analysis of data indicated significant (P<0.01) increase in the average AST activity with increase in the severity of the infection.
Bogin and Ziv (1973) reported that the release of various enzymes into body fluid was from damaged tissue or inflamed cells in mastitis. Moreover, the increased AST activity in mastitic milk was recorded to be caused by the liberation of parenchyma cells of udder and disintegrating leucocytes or both and other sources like serum.

2.1.7.1.6.4 Serum Creatinine level

In a study on sub-clinical mastitis in bovines conducted, Stojević Zvonko et al. (2005) obtained low values of the two enzymes, ASAT and GGT, along with a decrease activity of Creatinine. Contrarily, ALP activity increased in cows diagnosed with subclinical mastitis.

2.1.7.1.7 Evaluation of milk quality

2.1.7.1.7.1 pH of the milk

According to Marschke and Kitchen, (1985), the pH of normal cow's milk lies in the range from 6.5 to 6.8 but may exceed 7.0 in milks with high cell counts. The pH of normal buffalo’s milk ranges from 6.6 to 6.9 which indicate that it is slightly acidic.

Bilal and Ahmad, (2004) stated that the acidity of buffalo’s milk is due to the presence of phosphates, proteins and to some extent CO2 and citrates.

Khan and Muhammad, (2005) reported that the fresh milk contains no lactic acid. In a previous study, prevalence of clinical and sub clinical mastitis was higher in hindquarters than forequarters and among hindquarters left hindquarters were more susceptible than the right.
2.1.7.1.7.2 Surf field mastitis test

According to Ghulam Muhammad and Imaad Rashid (2012) the hidden form of subclinical mastitis is present in the quarter of udder, the mixture (milk + Surf solution) will thicken within 15 seconds.

2.1.7.1.7.3 California mastitis test (CMT)

Sears et al. (1993) reported that the CMT is meant to assist the producer in monitoring udder health. Results obtained from the CMT correlate broadly to SCC. Most positive CMT reactions indicate abnormally high SCC. Trace or weak CMT results, indicating a suspicious mastitis diagnosis, may suggest that the mammary gland is presently recovering from a previous infection or may be an early detection of mastitis. In either case, another CMT test should be performed to determine if mastitis is present and if any additional actions are needed. In contrast, distinct and strong positive CMT results on milk samples collected from individual quarters or composites indicate an ongoing inflammatory response characterized by elevated SCC.

2.1.7.1.7.4 Somatic Cell Count in milk

Somatic cells are mainly milk-secreting epithelial cells that have been shed from the lining of the gland and leukocytes that have entered the mammary gland in response to injury or infection. The milk somatic cells include 75% leucocytes, i.e. neutrophils, macrophages, lymphocytes, erythrocytes, and 25% epithelial cells.

According to Miller and Paape (1985) and Harmon (1994), during mastitis the major increase in SCC is due to the influx of neutrophils into the milk to fight infection and have been estimated at over 90% and the measurement of SCC in milk is known as a somatic cell count. High SCC present in milk is the main
indicator of mammary gland infection, caused by specific and non-specific microorganisms, which cause contagious and environmental mastitis.

As per the findings of Bytyqi et al., (2010) milk from a healthy mammary gland, the SCC is lower than $1 \times 10^5$ cells/ml, while bacterial infection can cause it to increase to above $1 \times 10^6$ cells/ml.

According to Dohoo and Meek, (1982) the SCC increases of greater than 200,000 cells/ml have been observed in cow milk as a result of bacterial infection. Various major or minor pathogens display a moderate increase in somatic cells of approximately 50,000 cells/ml. The magnitude of SCC response to major pathogens varies among cows, however, differentiation of types of pathogens seem impossible based on SCC alone.

2.1.7.1.7.5 Colour of the milk

Rasmussen (2001) reported that cows with blood or flakes in the foremilk had intermediate cell counts in composite milk. CMT-score of foremilk differentiated better between cows with high and low SCC in composite milk than visual inspection of Foremilk and he reiterated the need for visual inspection of milk which is suspected from a mastitis animal.

2.1.7.2 Foot and Mouth Disease

Coetzer et al. (1994), defined Foot-and-mouth disease (FMD) as a highly contagious disease of domesticated ruminants and pigs which can also affect a large number of wildlife species.

Donaldson and Kitchin (1989) reported that FMD was the first animal disease attributed to infection by a virus although the disease itself had been described as early as the sixteenth century in Italy. He further stated that FMD is a
vesicular disease, the clinical severity of which varies with the strain of foot-and-mouth disease virus (FMDV), as well as the infecting dose, the species and individual susceptibility of the host.

Alexandersen et al. (2003) in his findings mentioned that during the course of the disease, the affected animal produces virus in excretions and secretions such as saliva, nasal and lacrymal fluid, milk, expired breath, urine and faeces, which results in massive environmental contamination. Further, he added that, FMDV can infect most or all members of the order Artiodactyla, as well as a few species in other orders. Each species varies in its susceptibility to infection and clinical disease, as well as its ability to transmit the virus to other animals.

2.1.7.2.1 Clinical signs of Foot and Mouth Disease

According to Bartley et al. (2002) Foot and mouth disease is characterized by high temperature and blisters on the feet, surrounding the mouth, and on the mammary gland. Occasionally, vesicles may occur at other locations including the vulva, prepuce or pressure points on the legs. Vesicles often rupture rapidly, becoming erosions.

Kitching (2002) reported that Pain and discomfort from the lesions leads to a variety of symptoms including depression, anorexia, excessive salivation, lameness and reluctance to move or rise. Lesions on the coronary band may cause growth arrest lines on the hoof. In severe cases, the hooves may be sloughed off. Although FMDV does not cross the placenta, abortion may occur in pregnant animals.

In Foot and Mouth Disease, deaths usually occur only in young animals, as the result of multifocal myocarditis; vesicles are not always found. In some outbreaks, the mortality rate in young animals can be high. Severe disease may
also cause sudden deaths among older animals, particularly some species of wildlife, but this is rare as reported by Kitching and Alexandersen (2002)

2.1.7.2.2 Treatment for Foot and Mouth disease

In a statement by Kudi (2003) there was a strong agreement among the livestock-owners that some infectious diseases do not find sole solution in EVM. They have to integrate the ethno-veterinary and allopathic treatment to cure the ailments.

In a study conducted, the use of plant decoctions as external washes also has been reported by the livestock owners in literature (Nfi et al., 2001; Kudi, 2003; Pieroni et al., 2003). In the present study use of chemicals like copper sulphate solution made in water and used as external washes also reported by Pieroni et al. (2004).

According to Nfi et al., (2001), even now-a-days Fulani show a high degree of consistent ethno-veterinary knowledge. Along with the use of medicinal plants for the treatment of animal ailments the practice of “envenomation” is also common to prevent common epizootic diseases e.g. FMD.

Muhammad and Naureen, (2008) reported that in Sudan, saliva from infected animals is passed to the mouth of healthy ones and the lesions are treated with honey and glycerin. In Punjab (Pakistan) traditional age-old methods are used to treat FMD. Use of hot bread ‘roti’ mixed in oil or milk fat is fed to the animals. Also sick animal is forced to walk on hot soil/sand. Water from tannery containing tannic acid is also used for the treatment of feet of the infected animals.
2.1.7.2.3 Economic importance of Foot and Mouth Disease

Graves et al. (1968) reported wider effects on a country's ability to trade and export animals and animal products, and the cost of control measures to prevent entry or eliminate FMDV accounts for its main economic impact. It is the disease most feared by livestock holders and veterinarians and is an Office International des Epizooties (OIE) listed disease.

According to the findings of Kitching and Hughes (2002), adult animals generally recover, the morbidity rate is very high in naïve breeds, and significant pain and distress occur in some species. Sequelae may include decreased milk yield, permanent hoof damage and chronic mastitis. High mortality rates can be seen in young animals.

2.1.7.2.4 Haemogram in Foot and Mouth Disease

The normal haemogram values of the cows are correlated well with the report by Gokce et al. (2004). According to him, in FMD affected animals, there was a significant decrease (P<0.01) in haemoglobin content, total erythrocyte count and total leucocyte count. In recovered animals, haemoglobin content and total leucocyte count were recovering towards normal but the total erythrocyte count showed further decrease indicating the persistence of depression of erythropoiesis due to the disease. The differential leucocyte counts showed increased number and a non-significant change in neutrophil count in FMD affected animals. The increase in TLC was mainly due to increase in lymphocytes.

2.1.7.2.5 Leucogram in Foot and Mouth Disease

According to Mohan et al., (2008), experimental FMDV Asia 1 infection in Indian cattle and buffalo resulted in a transient, but marked decrease in the circulating leucocyte and lymphocyte levels. A significant fall was recorded on 1
day post infection in both cattle and buffaloes (p<0.05). He observed a significant reduced leucocyte levels lasted up to 3 to 5 days post infection and further leucocyte levels started recovering much early in cattle than in buffaloes. Further, he observed Lymphocyte levels showing similar variations as with total leucocyte count in both cattle and buffaloes. He pointed out that there was no significant difference in the levels of neutrophils, basophils and eosinophils.

As per the study conducted by Bautista et al. (2003), Diaz-San Segundo et al., (2006) and Bartels et al. 1994), the total leucocyte and lymphocyte level after infection decreased significantly, though transiently, indicating leucopenia with associated lymphopenia in both cattle and buffaloes. However, studies on naturally infected animals indicated lymphocytosis and also unaltered leucocyte levels (Mohapatra et al. 2005; Gokce et al. 2004; Elitok et al., 2005). Earlier studies have associated the lymphopenia in FMDV infected animals with impaired function of residual T-cells with a transient immunosuppression (Bautista et al., 2003; Diaz-San Segundo et al., 2006; Ostrowski et al., 2005; Parida et al., 2006). This facilitates viral pathogenesis including systemic spread and viral shedding into environment to enable its transmission. Leucopenia in buffaloes was relatively prolonged than cattle, which might be related to longer viraemia in buffaloes than cattle (Barya and Afzal 1969).

2.1.7.2.6 Serum profile in Foot and Mouth affected animals

According to Mohapatra et al. (2005) there was significant reduction in serum concentrations of total protein and albumin in the FMD affected cattle, when compared with the normal animals. As the liver function is severely altered in FMD affected animals, the total protein and albumin levels may be lower than
normal. The reduction in the urea content may be related to the damage of the liver.

2.1.7.3 Coccidiosis in Broiler chicken

Coccidiosis is a disease that is caused by protozoan parasites of the genus Eimeria, developing within the intestine of most domestic and wild animals and birds. Seven species of Eimeria (E. acervulina, E. brunetti, E. maxima, E. mitis, E. necatrix, E. praecox and E. tenella) are recognized as infecting chickens (Williams, 1999).

Although coccidiosis is a disease known for many years, it is still considered as the most economical important parasitic condition affecting poultry production worldwide. Based on a compartmentalized model, cost of coccidiosis in poultry in Sweden was estimated to be € 0.023 per kg live weight (Waldenstedt, 2004).

Sorensen et al., (2006) reported that almost 70 percent of cases are due to subclinical coccidiosis, by impact on weight gain and feed conversion rate. One of the reasons for these remarkable findings is probably the difficult diagnosis of subclinical coccidiosis, which prevents the industry to evaluate the best possible strategies for control of coccidiosis.

2.1.7.3.1 Clinical signs of coccidiosis

Birds with clinical cases of coccidiosis frequently display a typical 'sick bird' attitude with depression, prostration, huddling under the heat source as if chilled, soiled vents and watery or bloody droppings. One of the first signs of clinical and even subclinical coccidiosis may be paleness (Cervantes, 2002)
2.1.7.3.2 Treatment for coccidiosis using *Aloe vera*

Elbanna et al. (2012) reported that fecal oocyst shedding decreased significantly (p<0.05) in all of the treated groups that were supplemented with either aqueous extract of *Allium sativum* or *Aloe Vera* alone or in combination as compared to the infected nontreated control group. Furthermore, the medicated groups - showed significantly lower intestinal lesions (p<0.05) compared with those infected non treated ones. No significant differences were found in body weight gain or loss between the *Allium sativum* or *Aloe vera*-supplemented birds either alone or in combination and non-infected control group. In addition, Feed conversion rate (FCR) was improved in birds supplemented with either *Allium sativum* or *Aloe Vera* compared with non-infected birds.

2.1.7.3.3 Postmortem lesions of coccidiosis

According to Cervantes, (2002), in birds that have recently died, postmortem examination should start with examination of the intestinal tract and the caeca for the presence of gross lesions. Gross lesions caused by *E. acervulina* are usually the most prevalent and are usually confined to the upper small intestine (duodenum), although sometimes they may extend to the mid-gut (jejunum). The lesions have a unique appearance, consisting of white patches or transverse white lines inside the gut that may already be observed from the outside.

Lesions of *E. maxima* comprise multiple petechial (pin-point size) haemorrhages often seen from the outside of the mid-gut area, in addition, segmental ballooning or enlargement of the mid-gut with presence of orange-tainted mucous may be noted. However, unless the lesions are typical they are harder to identify than those caused by *E. acervulina* and *E. tenella* and therefore it is highly desirable to confirm its presence by identifying the presence of coccidial oocysts (eggs) in a scraping from the mid gut under a microscope.
Gross lesions of *E. tenella* are confined to the caeca and consist of the presence of haemorrhages on the outside or inside of the wall of the caeca, free-blood or a chocolate-coloured fluid content inside the caeca with a thickening of its wall or the presence of a large core of cellular debris and blood. *E. tenella* can kill birds so dead birds in a flock with increased mortality should always be examined for the presence of lesions compatible with *E. tenella* infection or caecal coccidiosis.

### 2.1.8 EXPERIMENTAL STUDIES

Biological screening is a necessary approach to provide a scientific basis for the continued use of the plants, thereby validating their traditional utilization. It is necessary not only to establish the therapeutic potential of medicinal plants but also for identifying and comparing various plant preparations for potency. Additionally, these studies aid to correlate the activity with some component in the plant. Thus biological screening along with chemical profiling aids in standardization of plant material.

#### 2.1.8.1 Toxicity studies of medicinal herbs used as Ethno veterinary medicine

Toxicological studies test help in the identification of possible target organs involved and the toxic symptoms. Studies of special toxicology such as carcinogenesis are very important if the plants contain compounds with known mutagenic or carcinogenic activities. It is recommended that a minimum of 2 or 3 mammalian species be used for the *in vivo* screen. Rodents like mice, rats, or guinea pigs are used in the initial screen to be used later in combination with other species such as dogs and monkeys. (Chanabra *et al.*, 2003)

It is possible that that the plant preparation taken up for clinical trial may lead to some unanticipated / unknown / unrelated side effect that may vary from
animal to animals. The use of herbal preparations may also lead to hypersensitivity reactions ranging from transient dermatitis to anaphylactic shock (Ernst, 1998). Many widely used medicinal plants have been implicated as possible causes of long-term disease manifestations such as liver and kidney diseases.

It becomes necessary to carry out toxicological studies, both short term and long term before initiation of clinical trials, and the risk-benefit ratio of the herbal drugs also need to be evaluated (Seth and Sharma, 2004).

Chronic supplementation with garlic at maximum voluntary intake resulted in Heinz body anemia, as characterized by reduced red blood cell count, free haemoglobin, hematocrit, and haptoglobin; and increased free bilirubin, mean red cell volume, mean red cell haemoglobin, platelets and incidence of Heinz bodies was observed by Pearson et al., (2004). He also stated that recovery from anemia was largely complete within 4 weeks after removal of garlic from the diet.

Until when toxicological, pharmacodynamic and pharmacokinetic data are available, traditional health practitioners must exercise caution in prescribing concurrently to their patients. The potential for drug-herbal interactions should always be borne in mind and conventional therapies should focus on treatment with proven, evidence-based strategies (Miller et al., 2004).

2.1.8. 2 Haematological Parameters

Uma devi et al., (2000), stated that the leaves of Ocimum sanctum contain a variety of constituents that may have biological activity, including saponins, flavonoids, triterpenoids, and tannins. In addition, the following phenolic actives have been identified, which also exhibit antioxidant and anti inflammatory activities, Rosmarinic acid ((2R)-2-[[((2E)-3-(3,4-Dihydroxyphenyl)-1-oxo-2-propenyl])oxy]-3-(3,4-dihydroxyphenyl) propanoic acid , apigenin (5,7-dihydroxy-
2-(4-hydroxyphenyl)-4H-1-benzopyran-4-one, cirsimaritin (5,4’-dihydroxy-6,7-dimethoxyflavone), isothymusin (6,7-dimethoxy-5,8,4’-trihydroxyflavone) and isothymonin. Two water-soluble flavonoids: Orientin (8-C-beta-glucopyranosyl-3’,4’,5,7-tetrahydroxyflav-2-en-3-one) and Vicenin (6-C-beta-D-xylopyranosyl-8-C-beta-D-glucopyranosyl apigenin), have shown to provide anti-oxidant effect in addition to blood cell forming activities.

According to Lili Zalizar (2013), flavonoids of Phylanthus niruri act as immunomodulators especially immunostimulators because it can increase activity and phagocytic capacity and antibody titer. Flavonoids of Phylanthus niruri did not affect the health of animals that seems of no consequences for hemoglobin, total erythrocyte and hematocrit.

Wagner et al. (1988) stated that the mechanisms of action of herbal drugs and their extract preparations differ in many respects from that of the synthetic drugs or single substances. This effect can be characterized as a polyvalent action and interpreted as additive or in some cases, potentiating. The exact mechanism of poly herbal preparation is not known, however, it may scavenge free radicals produced and may reduce induced damage to the cellular DNA.

Uma devi et al. (1999) mentioned in her findings that poly herbal drugs offer an alternative to the synthetic compounds and have been considered either non-toxic or less toxic and this has given impetus to screen poly herbal drugs for action.

2.1.8.2.1 Packed Cell Volume

Senturk et al. (2005) reported that the changes in blood parameters are due to the effects of anti oxidants such as \( \beta \)-carotene, poly phenols, ascorbic acid etc.
Khalil and Kotby (1982) explained that an increase in PCV content may be due to increased ambient temperature and hydration status of the rats.

2.1.8.2.2 Haemoglobin

Studies in experimental animals revealed an increase in haemoglobin content when fed with fresh Aloe vera gel (Anshoo et al., 2004).

2.1.8.2.3 Red Blood Cells

Red blood cells or erythrocytes are responsible for carrying oxygen to the body’s tissue. RBC’s contain the molecule hemoglobin.

Khalil (1981) states that oxygen that is taken into the bodies attaches to the hemoglobin as the RBC’s pass through the lungs. The RBC's then deliver the oxygen to all the other cells in the body and take the carbon dioxide back to the lungs. RBC's are formed in the bone marrow. The bone marrow constantly produces new RBC's, since the life span of an RBC is only about 120 days.

The body can respond quickly to maintain the number of RBC's present in the blood vessels. The body measures their numbers simply by evaluating the quantity of oxygen being supplied to its tissues. If not enough oxygen is available, then the body sees that as a need for more working RBC’s. If more RBC's are needed quickly, then more immature cells (called reticulocytes) are released into the circulation from the bone marrow. However, if there are adequate cells present, it slows down the release of new ones (Khalil and Kotby, 1982).

2.1.8.2.4 White Blood Cells

In an experiment conducted by Wenk (2003), with plant extract supplementation in pigs which were fed with the experimental diets exhibited no significant difference in the leucocyte count among the treatments.
2.1.8.2.5 Mean Corpuscular Volume

Mean Corpuscular Volume expresses the average volume of the individual erythrocytes. Increased MCV represents macrocytic anaemia due to the increased activity of bone marrow in some conditions usually associated with normocytic anaemia such as acute haemorrhage and hemolysis (Benjamin, 1985). He also stated that decrease in MCV is due to iron deficiency or some deficiencies in hematopoietic factors. MCV of rat erythrocytes is smaller, relatively high number of erythrocytes are required to support the higher haematocrit and haemoglobin content.

2.1.8.2.6 Mean Corpuscular Hemoglobin Concentration

The Mean Corpuscular Haemoglobin Concentration is the concentration of haemoglobin in the average erythrocyte.

Mbaijorgu et al. (2013) reported that the Mean Corpuscular Haemoglobin Concentration were significantly elevated and reduced according to their basal diet. Low protein diet significantly increased MCHC in groups relative to their respective control animals.

2.1.8.3 Study of Serum Chemistry in Rats

According to Nahal (2004), liver has great capacity to synthesize and detoxify the drugs and other substances. Many of the toxic effects are associated with the use of herbal drugs. Excessive use of herbal drugs damages multiple organs, especially the liver and kidney. In various cases damaging of hepatocytes has ranged to mild increase in liver enzymes to the liver damage.

Due to the structural damage of liver, the level of liver enzymes are increased in serum because liver enzymes are located in cell cytoplasm after
damaging or injury they are released into the blood circulation and raises the level of enzymes in serum (Etim et al., 2006)

According to the finds of Kim et al.(2009), Aloe vera has hepatoprotective effect in chronic and acute liver injuries through oxidative stress suppression. It has liver protective effect against hepatotoxic agent by restoration of normal hepatocytes.

Gupta and Misra (2006) reported that Aloe vera protects the liver from oxidative stress and inhibits the excessive free radicals accumulation. In Ayurvedic formulation, Aloe vera used for the protection of hepatocytes and it possesses many hepatoprotective constituents. Specific steroids and flavonoids are responsible to protect the liver from oxidative stress and play a key role as hepatoprotective agents.

Prakash and Gupta (2005) reported that eugenol, flavonoid and ursolic acid components, present in Ocimum sanctum leaves, have free radical scavenging and anti-lipoperoxidative effects. Therefore, the hepatoprotective effect of Ocimum sanctum leaves is due to the antioxidant properties of its constituents.

According to Sen et al., (1988), the membrane stabilizing property of Ocimum sanctum is responsible for its hepatoprotective action.

According to Singh et al., (1996), the fixed oil of Ocimum sanctum contains linoleic acid, which is responsible for its anti-inflammatory activity. Hence, linoleic acid may also be responsible for reversing the inflammatory features associated with hepatic injury thus adding to the hepatoprotective effect.
Saleem et al., (2010) reported that liver functions as an endogeneous metabolism center for nutrients, such as carbohydrates, proteins, and lipids, and also participates in disposal of waste metabolites. The organ also handles the metabolization or excretion of exogeneous drugs and other xenobiotics and hence, liver plays a major role in protecting and detoxifying the body from foreign substances.

Friedman (2003) reported that liver cirrhosis is a major disease associated with various pathological processes including progressive fibrosis, portal hypertension and carcinoma. Also, free radical generation, mitochondrial dysfunction and depletion of antioxidants lead to the progression of fibrosis and cirrhosis.

In the hepatotoxic rats, Galisteo et al., (2006) detected elevated levels of serum ALT, AST, ALP, and total bilirubin concentrations which were typically measured for assessing the liver function. Such enzymatic activities were in line with the earlier reports of him.

Gressner et al., (2007) reported that the increase in serum enzymatic activities is related to hepatic parenchymal damage since ALT is released from mitochondrial and cytosolic localization from membranal sites, and cellular rupture allows the enzyme to escape into the blood. The raised serum liver enzymes such as ALT, AST, and ALP in intoxicated rats compared to normal indicates necrosis of hepatocytes that results in the leakage of transaminase and the elevation of serum ALP from a possible cholestasis and this also can be attributed to the damage in the histostructural integrity of the hepatocytes.

Biochemical analysis indicated that parameters of interest read closer to the levels measured from the control rats. It is indicated that the extract treated the rise
of the serum levels of ALT, AST, ALP, and bilirubin, and the decline in the levels of albumin and total protein.

The reduction in the levels of these enzymes in the treated rats hinted that the PN extract has stabilized the hepatocytes membranes and interrupted the release of enzymes from liver into blood. The lowered bilirubin levels supported this action since it implied more stable erythrocyte plasma membranes were present in the treated rats.

These findings are consistent with those of Harish and Shivanandappa (2006) found that aqueous and methanolic extracts of *Phyllanthus niruri* showed inhibition of membrane lipid peroxidation.

In an experiment conducted by Vilasa et al. (2011) explained toxicity produced in liver due to the reaction of free radicals with lipids and proteins. Assessment of liver function was made by estimating the activities of SGOT, SGPT, ALP, Cholesterol, Bilirubin and Total protein.

Livergen had shown significant decrease in enzyme level of SGOT, SGPT, ALP, Cholesterol, Bilirubin and significant increase in enzyme level of Total protein. The polyherbal hepatoprotective formulation Livergen was effective at normal dose used in this study justifying its use as a hepatoprotective agent.

### 2.1.8.3.1 Total Serum protein level

*Aloe vera* showed highly significant decrease in total protein, in comparison to control animals group results showed that the total protein level in *Aloe vera* treated group after 7, 15 and 30 days was decreased much significantly (Nahal.2004)
According to Guyton and Hall (2006), serum protein has a role in oncotic pressure and reduction in oncotic pressure resulting in excess body fluid build up in the tissues causing oedema. If serum total protein level is not normal, further testing should be continued to identify that which type of specific protein level is decrease or increase.

There are several cases of Aloe vera induced hepatotoxicity also reported (Ha Na Yan, 2010)

2.1.8.3.2 Serum Albumin content

Rabbits after 15 and 30 days dosing of Aloe vera showed highly significant decrease in albumin, i.e. 3.8±0.1 and 3.6±0.1(g/dl) respectively and animals after 07 days dosing of Aloe vera showed significant rise in albumin, i.e. 4.3 ± 0.04 (g/dl) in comparison to control animals group, i.e. 4.2 ± 0.04 (g/dl). Results showed that the albumin level in Aloe vera treated group after 15 and 30 days was decreased much significantly than after 7 days of dosing (Nuzhat Sultana and Rahila Najam, 2013)

Albumin is mainly produced in the liver. The decreased level could be due to decreased production or increased loss, but this effect could be related to the effects of Aloe vera on liver. It contains several alkaloids that may induce or inhibit liver enzymes such as cytochrome P450 as well as the enzymes required for ethanol metabolism. He concluded that the long-term use of Aloe vera may cause hypoalbuminemia.

According to Guyton and Hall (2006), if serum total protein level is not normal, further testing should be continued to identify that which type of specific protein level is decrease or increase. If the level of serum total protein is below the
range that usually reflect low albumin level and it may be due to liver disease or acute infection.

2.1.8.3.3 Serum Globulin content

Sarita and Kumar (2010) reported that globulin is produced in liver and low levels of globulin could reflect impaired synthesis of proteins.

According to (Nuzhat Sultana and Rahila Najam , 2013) Rabbits after 07, 15 and 30 days dosing of Aloe vera showed highly significant decrease in globulin, i.e. 1.5±0.08, 1.5 ± 0.05 and 0.9 ± 0.07 (g/dl) respectively in comparison to control animals group, i.e. 2.2 ± 0.01 (g/dl). Results showed that the globulin level in Aloe vera treated group after 7, 15 and 30 days was decreased much significantly.

2.1.8.3.4 Alkaline Phosphatase level

According to Hamman (2008), Aloe vera slightly increased the level of alkaline phosphatase (ALP) after 7 and 15 days of dosing and it could be due to the availability of alkaline phosphatase which is a constituent of leaf pulp and exudates of Aloe vera but after long term administration, it does not increase the level of alkaline phosphatase indicating the hepatoprotective effect. In current study Aloe vera slightly increases the level of alkaline phosphatase (ALP), indicating the infiltrative liver disease or bile duct obstruction.

Tamas et al., (2002) explained the fact that the Alkaline phosphatase involved for the removal of phosphate substrate present in the protein leads to decrease amount of total protein, albumin and globulin, it could be due to the increase level of enzyme alkaline phosphatase (ALP).

Rubin (1995) reported that the membranes of hepatocytes become damaged releasing the enzymes into circulation causing elevation and mentione that it was
worth mention that the aqueous extract of Ocimum sanctum Linn. has a profound
effect in restoration of ALP levels towards their respective normal values.

2.1.8.3.5 Alanine amino transferase level (ALT)

In a study conducted by Girish et al., (2009), Aloe vera also decreases the
level of Alanine transaminase (ALT) or Serum glutamic pyruvic transaminase
(SGPT) after 7 day administration. For the detection of liver damage ALT is a
biomarker to evaluate the liver disease. This was supported by the findings of
Sudheer et al., (2011) that the reduction of SGPT indicates the restoration of
normal functioning of liver.

2.1.8.3.6 Aspartate amino transferase (AST)

Nayak et al. (2011) reported that Aloe vera possessed hepatoprotective
activity and reduces the level of SGOT but increased after 30 days. Aspartate
aminotransferase or SGOT is not only present in hepatocytes but also found in
skeletal, cardiac muscles and blood cells. The level is only increased after 30 days
of dosing indicating that the use of Aloe vera should be short term.

Kingshuk Lahon and Swarnamoni Das (2011) reported a significant
decrease in the serum ALP, AST and ALT levels. However, no significant
difference was observed in the total protein levels in groups treated with Ocimum
sanctum. The group of rats when treated with Ocimum sanctum showed a
significant decrease in the serum AST and ALT alone.

2.1.8.3.7 Total serum Cholesterol level

Adesokan et al. (2006) reported that there were significant reductions
(P<0.05) in serum LDL-cholesterol and Total cholesterol in rats fed with Aloe. The
reduction in LDL-cholesterol and Total cholesterol may be ascribed to selective
alloxan effect since diabetic control group which did not receive the extract also showed reduction and concluded that the mechanism of action of the extract will need further elucidation.

Rajasekaran et al., (2005) reported that Aloe vera fed to rats afforded a significant restoration of the polyunsaturated fatty acid composition, which is presumably mediated by the scavenging of free radicals and the control of lipid metabolism the major determinant of total cholesterol.

Sarkar et al. (1994) studied that fresh Ocimum sanctum leaves in the diet decreased the serum lipid profile in the normal albino rabbit. Similarly Suanarunsawat and Songsak (2005) reported that supplementation of dried Ocimum sanctum leaf powder in the diet suppressed the high serum lipid profile in diabetic rats. Though Ocimum sanctum leaves expressed the hypolipidaemic effect in normal and diabetic animals, it is not known which compounds contribute to this action. Since Ocimum sanctum leaves are rich in EO, it is possible that EO in Ocimum sanctum leaves is responsible for the hypolipidaemic action.

2.1.8.3.8 Serum Triglyceride level

Sekar et al., (1990) reported that studies with Aloe vera fed to rats showed a decrease in liver cholesterol, triglycerides, phospholipids and free fatty acids in diabetic rats after treatment with the Aloe vera extract. This reduction may be attributed to increased clearance and decreased production of the major transporters of endogenously synthesized cholesterol and triglycerides.

Kelm et al., (2000), Lima et al. (2000) and Lahlou et al.(2004) reported that eugenol and methyl eugenol, and the phenylpropanoid compounds, are the main components of extracted from Ocimum sanctum leaves. They reported number of biological effects of eugenol and methyl eugenol including hypotensive,
myorelaxant, antispasmodic and antioxidant effects. It was emphasized that eugenol has been shown to lower a high serum lipid profile in hyperlipidaemic mice.

2.1.8.3. 9 Serum Creatinine and Urea

Creatinine clearance calculated from creatinine concentrations in urine and plasma samples, and the urine flow rate, as well as urea clearance, is used to determine the glomerular filtration rate of the kidneys. Although not commonly done anymore, they remain useful tests for renal function.

Brenner et al., (1998) reported that the plasma concentrations of creatinine and urea could be used as indicators of nephrotoxicity. Low clearance of creatinine or/and urea indicates a diminished impaired ability of the kidneys to filter these waste products from the blood and excrete them in urine. As their clearance values decrease, their blood levels increase.

Henry (2001) reported that an abnormally elevated blood creatinine is diagnostic of impaired renal function. His study revealed that aloe induces a significant rise in serum creatinine. This is in consonance with the study of Avila et al. He reported the cytotoxic effect of aloe. This study suggests that aloe promotes nephrotoxicity, thus causing impaired renal function evident by an increase in serum creatinine concentration. This could also explain the electrolyte imbalance associated with the aloe use. The altered level of plasma sodium seen in aloe treatment might be as a result of sodium loss due to its cytotoxic effect.
2.1.8.4 Necropsy in rats

2.1.8.4.1 Gross lesions of liver and Kidney

No gross lesions were seen in the vital organs of the rats on the 2% A. maritima diet or of the control rats as reported by Barakat et al. (2012).

2.1.8.4.2 Histopathology of liver and kidney

According to Thomson et al. (1998), administration of high doses of onion (500 mg/kg) resulted in apparent histological changes in lung and liver tissues of rats.

As per the research findings of Alnaqeeb (1996), administration of low doses of garlic (50 mg/kg) to rats either orally or intraperitoneally had little effect on lung and liver tissues as compared to control animals. In contrast, administration of high doses of garlic (500 mg/kg) resulted in profound changes in lung and liver tissues of rats.

Abdelgadir et al. (2010) reported that in the liver of Wister rats had taken seed extracts of Lawsonia inermis. Degeneration of hepatocytes was observed in histological sections of liver derived from rats treated with 200mg dose, albeit to the same degree as in controls. However, at the dose of 1000 mg/kg/day acute pathological changes were observed in liver histology, viz. severe distortion and degeneration of hepatocytes, hyperplasia of bile duct epithelium, hyalinization of the wall of hepatic arteriolar branch in the portal area, progressive lymphocytic infiltration in the portal area. According to Treadway, (1998), liver is the major site of detoxification in the body for all drugs/toxins.
According to the studies of Abdelgadir et al. (2010), histological sections of the kidney derived from rats treated with *Lawsonia inermis* leaf extract at the dose of 200 mg/kg/day, showed normal appearance of the renal capsules and tubules while epithelial cell degeneration and desquamation were observed in the lining of the renal tubules treated at a dose of 1000 mg/kg/day, compared to the controls. Suggestive of some degree of toxicity and adverse effects on circulation at the higher dose. His results were in agreement with the findings of Adekomi et al., 2011 who detected scattered lymphocytic infiltration, congestion, haemorrhages, and degeneration or necrosis in the renal tubular epithelia and stated that kidneys are the main organs in the body susceptible to the toxic effects of drugs.